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ABSTRACT

The problem of malposture in the blind and its affect on orientation and travel skills was explored. A group of 45 students were enrolled in a standard 3-month mobility training program. Each student suffered a postural problem, some compounded by severe orthopedic and/or neurological deficit. All subjects were given complete orthopedic and neurological examinations as well as a battery of special psychometric tests. Postural problems were diagnosed and treated by a variety of therapeutic techniques, some newly described, including specialized exercise, splintage, and postural physical education programs. Improvement evaluation (by motion picture photography) was made before, during and after the 3-month program. The hypothesis tested was that improvement in posture contributed to improvement in mobility. The final results indicated such a correlation to exist. One implication is that postural training plays an important role in the development of mobility skills and thus in the total rehabilitation of the blind. (Author)

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FINAL REPORT

POSTURAL DETERMINANTS IN THE BLIND

(The Influence of Posture on Mobility and Orientation)

IRWIN M. SIEGEL, M.D., *Chief Investigator*
THOMAS J. MURPHY, *Project Director*

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August, 1970

This investigation was supported, in part, by Research Grant No. RD-3512-SB-70-C2 from the Division of Research and Demonstration Grants, Social and Rehabilitation Service Department of Health, Education and Welfare, Washington, D.C. 20201.

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Significant Findings For Rehabilitation Workers

1. Malposture is a common finding in the blind and contributes significantly to difficulty in orientation and mobility.

2. The problems of posture in the blind are peculiar to the state of blindness (particularly in the congenitally blind), and an understanding of their determinants is essential for proper diagnosis and treatment.

3. The specialties of orthopaedics, physical therapy, and specialized physical education can play a significant role in the diagnosis and treatment of malposture in the blind. These specialties should be utilized more fully in the total rehabilitation of the blind.

4. Therapeutic techniques, such as specialized exercises, training splints, balance training, mannequin brailling to improve body image, physiatric techniques to enhance vertical concept, and mobility training utilizing basic postural reflex patterns are effective in the treatment of malposture in the blind.

5. Postural evaluation is an important part of the total diagnosis of blindness, and postural training is often necessary to reach full travel (and rehabilitation) potential.

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Abstract

This study deals with the problem of malposture in the blind and its affect on orientation and travel skills.

A group of 45 students were enrolled in a standard three-month mobility training program. Each student suffered a postural problem, some compounded by severe orthopaedic and/or neurological deficit. All subjects were given complete orthopaedic and neurological examinations as well as a battery of special psychometric tests. Postural problems were diagnosed and treated by a variety of therapeutic techniques, some newly described, including specialized exercise, splintage, postural physical education programs, etc. Improvement evaluation (by motion picture photography) was made before, during and after the three month program. The hypothesis tested was that improvement in posture contributed to improvement in mobility. The final results indicated such a correlation to exist.

The implication of this work is that postural training plays an important role in the development of mobility skills and thus in the total rehabilitation of the blind.

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Foreword

The special problems of posture with which those without sight must cope, particularly as they affect orientation and travel, are apparent to all who train the blind. As an orthopaedic surgeon, I have treated many posture problems, but always in sighted patients. When I first became interested in malposture in the blind, I blindfolded myself and entered a world where posture, balance and mobility were not governed by sight. "If not by sight, then by what?" I asked. This single question inspired the project I am about to describe.

A review of the literature revealed that although practitioners had for years been aware of the postural problems in the blind, little had been done to investigate this matter. A survey by mail of leading agencies for the blind in this country and abroad produced no information of ongoing studies in this area, but each facility contacted expressed an encouraging interest in the thrust of this research. During the planning phase for this study, major facilities for the treatment of the blind were visited in this country. The lack of diagnostic and therapeutic techniques to deal with malposture in the blind was apparent. Additionally, the directors of all centers visited were hopeful of any help available in dealing with these problems.

It is our desire that this project will prove a fit beginning for continued research in this field. It is apparent that the skill of a variety of ancillary specialties can be well applied to the problems of posture in the blind, and, hopefully, this and similar work will inspire and intensify cross disciplinary exchanges of information and methods and further investigation of this vital problem.

Preface

Expression of Posture in the Blind

It is not empty rhetoric to refer to posture as an expression. Posturing is the principle method of communication among pre-human anthropoids and in modern man plays an important role in the expression of attitude.

By "posture" I mean a process, not a condition. A process of stabilization in motion as well as at rest. In this way an individual experiences the environment and conditions his response to it - his direct response, his expression, if you will.

An infant's posture is determined mainly by reflex mechanism. The development of binocular vision in the growing animal subserves the need for spatial orientation and gradually supplants the responses of postural reflex activity in orienting the organism and maintaining balance. Although this complex activity is disengaged in the sighted adult, it is nonetheless present and active at times of special need. Generally speaking, upper extremity postural reflexes are lost at an early age while those in the legs are retained into adulthood.

Human gait represents a closed kinetic chain in which there is an alternating loss and recovery of equilibrium. During the rhythmic play between swing and support in the lower extremities, accompanied by a shift in the center of gravity and resulting in forward propulsion and elevation of the body, postural reflexes are called into action. The ultimate refinement of these operations is the achievement of movement which is almost fluid and accomplished with the least possible expenditure of energy in a state of near relaxation. To realize this cosmetically and functionally desirable condition, an individual requires three things: 1) adequate spatial orientation including a valid concept of the vertical; 2) well conditioned postural reflex mechanisms; and 3) an appropriate and accurate body awareness, against which stance and motion can be patterned. The blind, indeed, are often wanting in these requisites. If any sighted individual doubts this, let him attempt travel while blindfolded.

The experience and expression of posture in the blind is predominantly regulated by those reflex mechanisms which vision supplants in the sighted. These include the tonic neck reflex, as well as positive supporting responses and other statatonic reactions. In addition, and this is particularly true in the congenitally blind, there is evidence to strongly suggest that an accurate concept of verticality, necessary for proper orientation, is lacking. Lastly, that body awareness and image, against which a blind person models his posture, are frequently in error.

Persistent malposture in the blind may cause discomfort and create serious difficulties in orientation and mobility. Any program designed to teach travel to the blind is incomplete unless it considers these problems, and any method for treating postural divergency which does not include techniques acknowledging the postural reflex, vertical concept and body image needs of the blind pupils is inadequate. Such techniques may include specific exercise programs, reflex splinting, and postural reconditioning aimed at improving the individual's proprioceptive spatial orientation.

Although faulty body mechanics can initiate difficulties in segmental alignment and subsequent postural problems, good posture is almost always synonymous with adequate kinesthetic awareness. It is to the improvement of this awareness that posture and mobility training in the blind should be directed.

Let us make no mistake, a person truly handicapped is one unable to fully use that with which he is naturally endowed. By exploiting effective postural reflex mechanisms, by training vertical spatial orientation, and by developing in each student an appropriate body image, postural illiteracy can be remedied and effectiveness in orientation and mobility enhanced.

In this way, the expression of posture in the blind need not be one of tension, fatigue, and distortion. Rather, it will reveal the freedom and dignity that accompany the dynamic sense of the upright which effective posture inevitably creates.

Purpose

The purpose of this research was to:

1) Investigate the determinants of posture and postural divergency in the blind (including body image, postural reflex ability, postural cognizance, and proprioceptive spatial orientation).

2) Study the correlation between malposture and mobility and orientation problems in the blind.

3) Develop diagnostic and therapeutic techniques for these problems.

4) Apply the above techniques to the vocational rehabilitation of a blind population.

Background Statement

A comprehensive definition of posture eludes anyone who concerns himself with its nature or its problems. However, its investigation is as old as medicine itself. It is mentioned in the Hippocratic texts. The very word orthopaedics, as coined by Nicholas André in 1741, is derived from the two words "orthos" (straight) and "paidios" (child). As early as 1670, Bernardino Ramazzini considered correct postural training in his classical paper on occupational medicine,and later in the early 1800's Jacques Mathieu, believing that deformities could be repressed or prevented by the development of proper muscular balance, incorporated a program of postural training in his orthopaedic sanitarium.

Posture then is not a condition, even though the earliest definition of the word (1628) was "to place in position, to set". Neither is it solely an attitude. Goff characterizes it as essentially "made up of meaningful motions of the body in relation to its many parts", and suggests that it be studied not only relative to the postulates of body mechanics, but also in "terms of poise, either in preparation for motion or in actual motion".

Howorth investigated the dynamics of postural movement. Although including the fundamental static positions of lying, sitting and standing, it is, he stated, through the dynamic positions of the body in action that posture becomes most important and most effective. "Movement is the basis of dynamic posture".

In 1961 McMorris described posture as the end result of the interrelation of parts of the body in their overall reaction to the pull of gravity. Another more inclusive definition has been proposed by Crowder. "It is essentially a psychosomatic phenomenon controlled by the brain, regulated by spinal reflexes, and executed by the muscles".

Thus, we come closer to a total conception of the complex event of posture. It has a psychic as well as a somatic component, and its functions, mediated through muscles acting upon the body articulations, are under reflex as well as conscious control.

The solution to any problem consists in reducing it to its elements. In this way we approach the study of malposture in the blind. Attention was given not only to body mechanics, but also to the reflex control of both static and dynamic body tensions. Also, the psychic influence on spatial concept and positions and its correlation with the other elements of postural sense were considered. Finally, evaluative and corrective techniques, using all elements of the postural complex, were developed.

Thus, it was the purpose of this study to examine the problem of posture in the blind, particularly as it relates to effective appearance, functional orientation, and efficient mobility. An outline of the determinants of posture, a review of the examination and diagnosis of malposture, and an outline of treatment techniques for postural correction will be presented.

Statement of the Problem

The research assumption was that the determinants of adequate posture and mobility in the blind include an appropriate body image, adequately functioning postural reflex ability, an appropriate perceptual cognizance, including a concept of verticality and optimal motor perceptual ability through proprioceptive spatial orientation.

Deficit in any of these areas causes postural divergency. Postural divergency adversely affects not only health, but mobility and orientation. The specific cause of such divergency can be diagnosed and treated, restoring the individual to a state of optimal postural efficiency and rehabilitation.

Data was collected on each member of the study group as to age, sex, visual status (total or partially sighted, congenital or adventitiously blind, etiology of blindness, etc.) past history of problems of malposture, ancillary illness, psychological status, etc.

Each subject was given a battery of psychometric tests to determine form concepts and their relationship to orientation and mobility activities. Each subject was examined to determine the postural status. Examination included a complete orthopaedic evaluation, as well as a neurological examination to determine the subject's state of kinesthetic awareness. The research tools outlined below were utilized in this examination. Each subject was programmed in consultation with the research staff (project director, physical therapist, peripatologist, psychologist, and other ancillary personnel,as indicated). Treatment utilized weights, braces, exercises and equipment outlined below. Comparisons were drawn between the student's proprioceptive spatial orientation, postural reflex, body image, perceptual cognizance, and the student's ability to perform mobility tasks requiring adequate posture upon admission to the Institute, during training, and upon conclusion of training. Permanent records of these findings were kept through photographic techniques. Changes were verified by a panel of orientation and mobility experts. They rated the students as unimproved, improved, markedly improved. These three groups were studied for characteristics which might be helpful in predicating success or failure of a particular student and the results of the Institute program.

Review of Literature

If good posture results in balanced coordination without strain, then good posture is a goal to be sought, particularly by the blind who require the freedom of effective mobility.

It has been said that "posture has a direct relation to the comfort, the mechanical efficiency and the physiologic functioning of the individual" and "faulty posture can directly or indirectly impair proper circulation and body metabolism". Muscular efficiency is decreased and abnormal tensions and strains are placed on the joints and their allied structures.

Pain secondary to malpostural muscle tension, particularly in the back and neck, is a common complaint in postural strain syndromes. Muscular and para-articular stress secondary to malposition of body parts can aggravate and accelerate a preexisting arthritic condition. An excellent survey of those diseases caused or aggravated by poor body alignment has been written by Kuhns. The extent and seriousness of malposture in the sighted population have been reported by Michele and Crowder. The latter author in his interesting review on posture and body mechanics pointed out that the examination of young men and women entering the British Armed Forces disclosed that over 75 per cent had a postural error of some kind.

Similar studies with the blind have been few, but as early as 1917 Swinerton editorialized on the need for "corrective gymnastics" in the treatment of some postural defects and habit motions among the blind. In 1930 the same author reported on the orthopaedic examination of 180 students at the Perkins Institute for the Blind, among whom were found a total of 260 structural* or flexible** postural defects.

Boettger, writing on the objectives of physical education in the blind, outlined an exercise program for postural correction which would help to instill proper habits of thought and feeling as well as of action. Other authors have emphasized the need for such training programs in the overall rehabilitation of the blind. Strnad in 1963 reported on the examination of 60 pupils (school for youths with visual defects in Prague, Czechoslovakia) and found that 77 per cent had postural defects including defective deportment and spinal deformity.

It has been our observation that postural defect inhibits efficient gait and use of the cane. This situation is often overlooked in the travel training of the blind, much to the detriment of effective mobility.

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*noncorrectible through exercise

**secondary to faulty postural habits and correctible through exercise.

Hoover, in discussing orientation and travel techniques for the blind, noted the need for better methods of travel training. The development of such methods should include examination of the determinants of posture, the influence of poor posture on movement, and the integration of postural correction into the mobility training program.

Posture - Some General Considerations

Rehabilitation is the restoration of the disabled to the fullest functional attainment to which he is capable. In the blind this concept is of particular importance because such individuals have to live and compete in the world at large where it is often necessary that they appear and function at least as well as, if not better than, their sighted peers.

One of the keystones in the bridge from blind disability to ability despite blindness is good posture. As almost poetically stated by Howorth,

> "Good dynamic posture frees the individual from tension and gives the body a feeling of lightness, moving through space rather than being earthbound. The body then becomes the instrument of the individual rather than the anchor dragging at the day's activities. The tendency to fatigue is reduced and there is more energy left for other things. Accidents are less common and usually less serious with good dynamic posture. The principles of good dynamic posture, precision, smoothness, power, balance, good timing, rhythm, coordination may be used not only for the physical body in action but also as an approach to life itself."

Lowenfeld pointed out in his article on the effects of blindness on the cognitive function of children, that restriction in mobility potential can be regarded as the most severe single effect of blindness and that educational methods for training of the blind in the area of mobility should aim at developing the highest degree of independence by cultivating each individual's full mobility potential. This investigator further observed that the blind are frequently disturbed by a fear of being observed by others, so that they feel they must control their movements and behavior, thus producing a state of self-conscious tension.

We have noted that the development of postural poise, or what might be called dynamic cosmesis (the sense of creating a good appearance), can do much to relieve this tension. The response that one evokes from the environment helps construct the image that one has of oneself. This constant feedback in great part determines one's attitude and responses to the world. In short, it is important that the blind individual create an image of relaxed equilibrium and mobile independence.

Although any postural problem may be found in the blind, those defects most frequently seen include pelvic tilt, increased lumbar lordosis (swayback), thoracic kyphosis (round back),and flat chest. In association with these deformities, we frequently note abdominal protrusion and knee flexion with advancement of the head, neck, and shoulders. Also seen are wide-based gait with out-toeing (duck waddling gait).

Habitually poor posture, such as described above, overstretches certain muscles and ligaments while allowing others to relax. The stronger shorter ones contract, perpetuating the ill effects of the original malposition. Aside from the symptoms and specific effects of this faulty deportment, including visceroptosis, decreased respiratory function, pes planus (flat feet), back- and neck-ache, leg and foot pain, and a general emotional attitude of depression, such a stance and the gait it produces interdicts the sureness of carriage necessary for good mobility and travel.

Good postural balance is secured by maintaining the center of gravity over the feet. In the sighted, occular coordination plays a major role in obtaining this. In the nonsighted, the semicircular canals and the proprioceptive sense of the muscles and joints subserve this function entirely. With the body moving forward, the center of gravity advances in front of the feet and provides forward momentum. In this sequence the head leads and the body follows.

The Basis of Postural Control

Posture is not a state, it is a process. It is determined by impulses received in the spinal cord from muscle, from tendon, and from other proprioceptive structures. It is therefore in a state of continuous adjustment. Barlow suggested the term "postural homeostasis" be used to cover this idea, "in order to get away from the usual concept which for most people implies some fixed position which can either be right or wrong."

Other important physiological findings relevant to an understanding of posture control have been enumerated by Burt and Turner. In their article on faulty posture they refer to Crowder who demonstrated differences in blood flow to muscles during dynamic activity as well as static activity when blood supply does not equal blood demand.

These authors also mention the work of Cathcart who stated that when the static element in muscular effort becomes dominant,"static expenditure is parasitic on dynamic work." The more static the work becomes, the greater is the fall in efficiency.

Based on these considerations, certain principles of treatment were postulated by Burt and Turner: 1) Because less information is received by the central nervous system when muscles are contracted than when relaxed, and because the blood supply of muscles is decreased during static contraction,the correction of faulty posture by muscular relaxation techniques is physiologically sound. 2) Because the higher centers acting on the muscle spindles play a considerable role in forming the postural habitus, an important part of correctional technique must be the substitution of a good for a poor postural body image.

Sherrington in "The Integrative Action of the Nervous System" distinguished and investigated the reflex system which "maintains that steady tonic response which supplies the muscular tension necessary to attitude." Brain, in discussing these matters, referred to the classic work of Magnus and DeKleijn with tonic neck and labyrinthine reflexes in supporting Sherrington's idea that the head plays a significant part in regulating bodily posture.

Of those physiological mechanisms subserving the maintenance of postural tonus, the tonic activity of muscle is, from the standpoint of postural correction, the most significant. This activity is controlled by a spinal reflex, known as the stretch reflex, which involves a servo-mechanism; that is, one in which the control system is to some degree regulated by data feedback from the system controlled. Electromyographic studies have revealed that in tension states leading to increased muscle tonus, prolonged muscle contraction decreases "feedback to the central nervous system." Thus, information about position sense is not supplied to the subject and he is unaware of his abnormal posture. The importance of this observation in the postural care of individuals lacking sight and relying almost solely on proprioceptive postural information should be apparent.

Barlow, in elaborating his approach to postural re-education, emphasized the association of faulty posture with maldistributed tension. He, as Sherrington, Magnus and DeKleijn, believed that "the primary defect in postural disorders is usually in the region of the head and neck". He spoke of bodily disposition and behavior (rather than structure) as determining the mechanics of the body. By behavior he referred to all the habitual motor responses with which the body reacts to the outside world and by means of which individuals adapt themselves to stress. His system of postural education involves the reconditioning of correct tensional balance through demonstrated instructions.

As has been noted, static holdings serve only to fatigue muscle and decrease the afferent flow of proprioceptive information. If remedial exercises are to be used in a program of posture retraining, their final object should be the development of new postural reflexes. This can usually be achieved by repetitive postural movements which begin and end in a position of correct posture and by habitual adoption of correct posture with conscious correction each time it flags.

Finally, every enlightened system of posture training should take account of the concept of body image (postural awareness). As noted by Crowder (loc.cit.), "the body image is a component of the personality and conversely the personality is reflected in thebody posture, just as it is in the individual's speech or dress." Barlow stated that "the cause of the problem of postural control is the subject's postural awareness, and, at a different level, the postural model or body schema which the subject uses is a standard against which he detects his postural error. One soon finds that postural awareness occupies the key position in determining a person's idea of himself and that as this awareness alters, profound alterations may take place in habits of thought."

It is our opinion that in the absence of sight, proprioceptive postural reflexes, such as the tonic neck reflex,are major determinants of postural attitude. It is also our impression that the concept of verticality and an individual's body image, particularly as they relate to spatial orientation, are grossly distorted in the blind individual. Such factors profoundly affect posture and mobility in the blind and must be taken into account in any sensible program of postural training for the blind.

Postural Reflexes

To discuss posture without examining postural reflex would be like discussing art without mentioning color, or music without considering tone.

Experimenters and clinicians alike have long been aware of the importance of postural reflex in establishing body set both at rest and in motion. The fundamental work of Sherrington and Magnus and DeKleijn, as well as others, laid the experimental groundwork for clinical study of these phenomena.

The postural reflexes are automatic reactions maintaining body orientation. Postural adjustments are constantly under the control of sensory organs located within the joints of the neck and the labyrinth of the inner ear. Coordination of axial and appendicular posture is primarily determined by head position. According to Magnus, position of the head exercises the prime influence on body attitude. Head turning initiates tonic neck reflexes which are integrated in the upper cervical segments of the spinal cord. Rotation of the neck produces extension of the limb on the side toward which the jaw is rotated and flexion of the contralateral limb. Dorsiflexion of the neck produces forelimb extension and hindlimb flexion, whereas volar flexion produces forelimb flexion and hindlimb extension. The muscle tone excited by these reflexes has been shown to produce very little fatigue, and therefore appropriate postural attitudes can be maintained with minimal energy expenditure. As Sherrington noted, "one great function of the tonic neck reflexes is to maintain habitual attitudes and postures. They form, therefore, a nervous background of active equilibrium."

In addition, secondary tonic reflexes contribute to the coordination of muscle tone and attitude throughout the body, thus maintaining characteristic body orientation. Stretch reflexes, positive supporting reactions, righting reflexes and other statotonic reflexes, produced by movement of the head or limbs (linear acceleration, angular acceleration, etc.) integrate to produce the total complex of postural tone.

As early as 1938, Gesell described the tonic neck reflex in the normal human infant. He explained this phenomenon on the teleological basis that "man does not face the world on a frontal plane of symmetry, but at an angle... and he makes his escape obliquely. This orientation is prefigured in the tonic neck reflex attitude of infancy... It subserves adaptations to the environment, prior to birth, as well as later."

Bieber and Fulton further related the grasp reflex to the tonic neck and labyrinthine reflexes. Kesareva investigated the phenomena of tonic neck reflexes in normal adults using myotonographic and tonometric methods. It was his opinion that the main significance of these reflexes lies in their contribution to the preservation of body balance.

Two of the most searching studies of the role of postural reflex activity in normal human beings are those of Fukuda and Hellebrandt et al. The former, reporting in the otolaryngological literature, illustrated the importance of these reflex phenomena in the kinetics of everyday activity and athletics. In his excellent monograph which demonstrates and documents the fact that the tonic neck and labyrinthine reflexes regulate head and limb movement, it is shown that the basic dynamic posture position described by Howorth (vide supra) is also the most efficient dynamic postural position from the point of view of postural reflex. Reference is also made to the sport of fencing as an excellent postural reflex conditioner,and this will be discussed later in this report.

Hellebrandt and associates reviewed the literature which revealed "an increasing appreciation of the contribution of neck and labyrinthine proprioceptive mechanisms to motor coordination in the intact organism." In their laboratory they confirmed the presence of tonic neck reflexes in normal human adult subjects. Another study which has shown results concordant with those mentioned above is that of Wells.

The utilization of head and neck posture to facilitate work-output has been reported by Latimer, and Walshe believes that reflexes regulating head posture might arise in the limbs themselves. In 1956 Hellebrandt et al demonstrated the facilitation of purposive stress movements by reflex head and neck positioning, concluding that "... reflexes arising in the limbs themselves during heavy resistance exercise in man regulate the posture of the head and this in turn expedites performance..."

The literature is replete with papers illustrating the role that reflex postural phenomena play in pathological states of the central nervous system. A study of these reflexes in thalamic man was made by O'Neill and illustrated that, indeed, as Magnus and DeKleijn demonstrated in their laboratory preparations, tonic cervical reflexes govern head position relative to the body while labyrinthine reflexes govern spatial position of the head in relation to gravity.

Further clinical observations reported by Simons in the German literature, beginning in 1920, have been abstracted and translated by Brünnstrom. The influence of tonic neck reflexes on the activity of trunk muscles in patients with respiratory illness has been noted by Moltke and Skouby. As mentioned before, Walshe postulated synergic postural fixation from limb activity, and in a treatise on postural reflexes in hemiplegia described tonic reflexes arising in the limbs and acting on the limbs, as well as tonic reflexes arising in the neck and acting on the limbs. Yamshon and his associates have examined the therapeutic implications of the tonic reflex in the hemiplegic. Finally, such investigators as the Bobaths have studied and used postural reflex activity directly in the treatment of spastic paralysis.

In discussing the role of the basal ganglia in locomotion, Martin reported several phenomena which relate much of this to the problem of posture and mobility in the blind. Investigating the physiological mechanisms concerned in the postural adjustments of locomotion, he described the normal side to side movement which occurs upon weight transference from one foot to the other and back again, the swaying of the upper body counterpoising the swinging leg, and the forward motion of the center of gravity which provides propulsion. He noted that ordinary visual stimuli are not adequate to excite the postural reactions of walking* and that the effects of body rocking may be due partly to reinforcement of proprioceptive stimuli from the joints, thus strengthening proprioceptive reflexes from the extremities. He asserted further that visual reflexes have more effect on the lateral postural ajustments of walking than on anterior-posterior control.

Other reports have touched upon these matters. Critchley makes reference to proprioceptive stimuli in stating that "blind people are perhaps more mobile and restless than sighted ones... these movements may be so exaggerated as to constitute curious stereotype tic-like mannerisms - - blindisms as they are called." Indeed, Müller, observing 340 blinded children, enumerated a variety of rhythmic motions in 34 per cent. Our observations have been that such mannerisms may well represent an effort on the part of the blind individual to compensate for loss of visual orientation by an overstimulation of labyrinthine and proprioceptive joint function. Certainly, rocking and swaying are seen frequently enough among the blind to represent more than a casual occurrence.

As Halpern has shown, "normal statokinetic function is the result of steady, correct perception of the horizontality of the ground planes and of the vertical planes passing symmetrically through the two halves of the body." Lacking optic function for this perception, the role of neck proprioceptive mechanisms in body orientation and motor coordination becomes paramount. Bodily attitudes change with change of head position, the proximal end of the body acting as a leader for its distal segment.

Wapner and Werner have determined that information relayed from neck proprioceptors has an important influence on the organism's ability to orient. These investigators found that a vertical rod appeared always to rotate to the opposite side from that on which an electrical stimulation of the neck was induced. Cohen ablated neck proprioceptors in monkeys and created severe deficits in orientation ability and motor activity. On the other hand, surgical detachment of extraocular musculature in his animals did not cause any observable disorientation or incoordination. Jones and his associates, in an outstanding series of studies, developed a method of utilising interrupted light photography to record the effect of head posture upon patterns of movement in man,and described an empirical technique for changing the distribution of postural tonus by changing the poise of the head, thus proving that habitual patterns of movement in posture can be modified by training in kinesthetic perception. It has been suggested that this method reflects the operation of the head and neck reflex elucidated by Magnus and DeKleijn.

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*It has been demonstrated elsewhere that proprioceptive impulses are not mediated by extraocular muscle without visual loss.

As has been pointed out, the therapeutic significance of postural reflexes has been successfully exploited by Barlow. In addition, electromyographic demonstrations of muscle work output facilitation have indicated that movements at first evoked only reflexly, can be brought under willful control through systematic training. The work of Wapner and Werner revealed that when the head or body is tilted to the right, the apparent position of the vertical is objectively tilted to the left and vice versa. Further, it has been confirmed that with changes in postural status,there are not only changes in the organization of space, but also in the distribution of sensitivity. McFarland, Werner and Wapner have shown that head and body tilt left increases right-sided sensitivity and shifts the straight ahead to the right and vice versa. This ideation of tactile and kinesthetic (proprioceptive) sensibilities is elaborated by Bender and Elizan who demonstrated that defects in the perception of the direction of drawn lines are always associated with an impairment of sensory function mediated by the "proprioceptive" system. It is thus plausible to postulate a relationship between sensitivity distribution and organization of space.

To summarize, lacking the means for visual orientation, the nonsighted individual relies primarily on reflex proprioceptive mechanisms to maintain posture and to locomote. These mechanisms are, of necessity, exaggerated because the individual is seeking to compensate for loss of the ability to orient visually.

Primary among the reflex mechanisms creating this background of postural tone that makes all orderly movement possible are the tonic neck reflexes described in detail above. The head leads and the body follows.

Misconceptions as to the true vertical as well as the body's position in space can and frequently do occur because of adventitious head and body tilt. In an effort to orient exclusively through the use of proprioceptive mechanisms, swaying, rocking, tilting and other objective signs of malposture occur. Indeed, the very act of extending the cane bearing arm initiates a widespread synergic postural fixation, the arm in this case acting as a handle which turns the head and thus the body, there being a reciprocal reflex relationship between limb, head and body posture.

As Jones and O'Connell have stated, "posture is a manifestation of the changing relationship among the parts of an integrated whole." Therefore, to deal intelligently with any problems of postural disorder, but particularly those of the blind, one must evaluate malposture in terms of what postural reflexes are in force and what reflex maneuvers can be used to modify postural set.

Spatial Perception

To organize reflex activity into effective posture, the organism must employ an accurate idea of true vertical. Numerous investigations into various determinants of such a concept have been conducted. The research of Wapner, Werner, and associates has led them to postulate a sensory-tonic field theory of perception. Witkin has gone a step further, correlating certain aspects of perception with a theory of personality structure.

Werner posits structuring of a perceptual field not alone as a sensory, but also as a "tonic"field. He quotes studies which demonstrate the influence of sensory stimulation upon the distribution of tonus, as well as experiments indicating that tonus has formative power in structuring a perceptual field within the organism. Thus, space as perceived by the individual is organized "...not as a purely sensory area, but as a sensory-tonic field."

In an effort to elucidate the effects of extraneous stimulation on object perception, Wapner, Werner,and associates found that "...verticality is a spatial property of an object which can be experienced by kinesthetic as well as by visual clues." These investigators found that to blindfolded subjects the position of a rod kinesthetically perceived as vertical was objectively tilted to the left when either the head or body was tilted to the right , or the body was accelerated in a clockwise direction or decelerated from constant counter-clockwise rotation. For opposite test conditions, the respective displacements were in the opposite direction. These effects had been previously described by the authors utilizing visual perception of verticality. Werner et al further demonstrated that "... under identical angles of body tilt, the position of a rod indicating apparent verticality is displaced to a greater degree from the perpendicular when the body is unsupported than when it is supported...and angle displacement of the apparent vertical increases with an increase of body tilt." Thus, the sensory-tonic field of perception defines posture as a dynamic state involving the continuous patterning of reflex processes,the efficacy of posture residing in these processes rather than in body position per se.

Lacking a visual field, one perceives the direction of gravity through the continuous pattern of adjustment which the body is making to its pull. Witkin and Asch's excellent review on this subject describes the phenomenon of perception of displacement of the upright to the opposite direction of body displacement with large body tilt (Aubert or A-phenomenon) and perception of displacement of the upright toward the body with small body tilt (E-phenomenon as named by Müller).

These experiments are significant in that they emphasize the importance of vision in perception. In the absence of sight, a host of factors including illusions of size, depth and distance, as well as the postural basis for judgment attempt to substitute for the visual frame of reference. Such estimates of verticality were found to be most accurate when the body was upright, but significant error appeared as soon as the body, or even the head alone, was tilted. Minor changes such as these had very disturbing effects on a subject's ability to orient to the vertical when deprived of visual clues. This illustrates the limited usefulness of postural determinants alone in providing the organism with a valid concept of verticality. Witkin postulated that errors in perception of the vertical lie in the individual's "particular mode of perceiving this situation, or in the suppression of certain experiences under conditions of sensory conflict". A provocative finding in one study was that women as a group make greater errors in perceiving the vertical than do men.

The aforementioned work has been complemented by experimental data from a number of laboratories. Significant decrease in the precision of judgment of postural vertical from lateral tilt positions was noted with modification of nonlabyrinthine proprioceptive cues by Mann and associates. In studying perceived location of objects and one's body under erect and tilt situations, using both visual and tactual-kinesthetic testing, McFarland, Wapner and Werner found that, in general, the position at which the body appeared to be was rotated beyond the physical body position in the direction of body tilt. whereas the apparent vertical was rotated beyond the physical vertical opposite the direction of body tilt. Unsupported body tilt increased the change for apparent vertical and decreased the change for apparent body position.

It is of interest to note that in reviewing the problem of contralateral deflection of the vertical, Sandström remarked that "deviations from the true upright with head tilted to the left are less than with head tilted to the right." Sandström, incidentally, offers an excellent summary of the Aubert and E-phenomenon to which previous reference has been made.

Fleishman, experimenting on the "perception of body position in the absence of visual cues", also concluded that greater precision of adjustment to the upright position results when the direction of displacement of the body is to the left rather than the right. He found that precision of adjustment was increased when head position was fixed under experimental conditions of body tilt. Smith through a series of ingenious experiments with displaced vision demonstrated that perception of the upright involved visual, cutaneous and gravitational-postural effects in "defining a frame of reference for orienting the body in space".

In summarizing the recent research on nonveridical perception of verticality, Curran and Lane asked for objectification and clarification of the roles that various conditions play in contributing to erroneous estimates of the upright. They noted that "minimal visual cues had a dramatic effect in reducing nonveridical perception of the vertical", and believe that inferences drawn from the sensory-tonic field theory of perception which suggest that the degree of muscular involvement plays an important role in determining judgments of body position must remain tentative. Curran and Lane suggested that the "use of multi-dimensional experiments with uni-dimensional variables, sampled at several levels and measured on ratio scales, facilitates the analysis of interaction effects in the perception of the upright."

Although we move in only three dimensions, we live in four, and the element of time must be taken into account to complete our consideration of vertical perception. In commenting on "temporal factors in the perception of verticality", Cohen and Tepas found, as did Mann and Passey, that prolonged exposure to conditions of postural tilt increased errors and judgments of verticality. Practice in the perception of postural vertical, however, resulted in a significant reduction of error in such judgments. In a series of experiments by Solley there was improvement in accuracy of perception with practice. Solley also noted (contrary to the work of Sandström and Fleishman) that left head tilt produced more error than right head tilt and postulated that this was due to the fact that the muscles on the right side of the body are stronger than those on the left or because of "long enduring habits of turning in one direction more often than the other".

This important evidence, namely, that with repeated testing, subjects show a significant reduction of error in perception of the vertical and that practice serves to bring about improved performance in such judgment, as demonstrated by Solley and affirmed by Pearson and Hauty, is important because it indicates the possibility of training perception of postural verticality. If such perception can be a function of learning, it is feasible that with proper techniques, instruction can be utilized in developing vertical perception in a nonsighted subject.

In sum then, although perception of the vertical is a multidimensional affair, and its final elucidation clearly requires a broad program of research, body position and support, visual, proprioceptive, labyrinthine, and tactual cues all contribute to false judgments of the upright.

Another variable contributing to this perceptual estimate is equally as important, though somewhat less accessible for investigation. This variable is non-reflex and non-somatotonic. It is psychological. It represents the psychic influence upon the somatic response.

Body Image

According to Gesell, the organism has the innate tendency toward "the organization of postural tension, attitudes, and movements." This organization structures the basis for motility. It has been proposed that the individual's perceptual experience conditions the ability to be motile, perception of body position thus bearing a direct relationship to motor tasks and skills and appropriate body orientation depending upon accurate spatial localization of the body as well as environmental objects. That physical asymmetry may lead to disorientation has been postulated by Lund. This investigator correlated structural asymmetry with the tendency to veer in subjects whose visual sense was excluded. The work of Wight and associates has confirmed the idea advanced by Wapner, Werner, and Morant of a "central, common field of interaction between sensory and motor functioning."

An understanding of the role of the individual's psychic perception of his body in space is important for a complete knowledge of the basis for mobility and has, as we shall see, practical implications in the understanding and treatment of posture and mobility problems in the blind.

Bennett quoted Scott's definition of body schema as "that conscious or unconscious integration of sensations, perceptions, conceptions, affects, memories or images of the body from the surface to its depths and from its surfaces to the limits of space and time". In this same review the concept of Head and Holmes of a "postural model of the body", which is plastic and modified by every new posture and movement representing "the fundamental standard against which all postural changes are measured", is also presented.

That the postural image of his body which an individual carries influences his perception of the upright, has been suggested by many of the investigations summarized earlier in this study. Although knowledge in this area is still limited and all aspects of the problem have not been fully explored, it would appear that we owe to our psychic body image the "power of projecting our recognition of posture, movement, and locality beyond the limits of our own bodies".

Whether this conceptualization (body image or body schema) is in isomorphic relationship to the level of motor skill is not important. The essential matter is that such a variable exists and exerts an influence on postural status.

An analysis of space perception in congenitally blind and sighted individuals by Hunter has indicated that the blind lack the ability to utilize various types of stimuli to the degree accomplished by the sighted. Epstein, examining the relationship of certain aspects of body image to the perception of the upright, postulated that "the degree to which one conceives of his body structure as differentiated, integrated, and free from distortions tends to increase with the ability to rely on bodily sensations in determining one's orientation to the upright." The idea that "body image" not only defines the individual's concept of his body, but also influences his perception of it, has been reviewed and extended by Fisher.

The physical problems of blindness cannot alone account for all manifestations of this disability. It has been observed that with sighted children emotional disturbances betray themselves in postural difficulties. Burlingham, in reporting on the development of the blind, notes that the same may be true for blind children, "beyond the awkwardness which is caused by blindness". In speaking of blindisms, this author states, "it is difficult to say how far these rhythmic activities merely substitute for the more normal muscular activities and discharge of aggression which the blind children lack, and how far they have the full value of autoerotic manifestations."

In considering the psychological problems of the congenitally blind child, Cole and Taboroff suggest that much of the difficulty these children have is due to their difficulty in imagining "a good external reality, a knowledge of self versus non-self."

The reduction of his repertoire of responses can lead to a distortion of body concept and consequently a disturbance of perceptual orientation in the blinded individual. This has been noted to be more severe in the congenitally blind than in those adventitiously blinded. Such deficits of spatial perception and orientation in the blind have been documented by a number of studies.

Studying the problem of body image, Kitamura reported that blind persons overestimated body height. The conditioning of perception of the upright by set (such as uncertainty) has been examined by Gross, and he observed that when an element of uncertainty is introduced into the experimental situation, an increase in error of judgment results. Adaptation in such a situation can occur, however, as the work of Passey and Guedry has indicated. These authors noted that "aircraft pilots report that a gradual departure from 'straight and level' flight with maintenance of inclination for some period of time leads to a feeling of 'straight and level' in the tilted position. When a subsequent return to the 'straight and level' is made, bank and turn in the opposite direction is often reported".

This potpourri of seemingly unrelated material has practical implications in considering the problem of postural training in the blind.

The image that the blind person has of his body in space, as it influences his perception and through this impression his mobility, can be conditioned adversely by set and adaptation. Emotional problems may further distort body image and mobility as the dynamic presentation of this image.

These phenomena are all germane to a complete understanding of our subject and until fully elucidated, the matter of malposture in the blind will not be entirely resolved. Following is a report on an attempt to clarify some of these questions in an effort to take the initial step toward solution of the problem.

Biomechanics of Gait

Some understanding of the essential features of normal locomotion is important to anyone dealing with mobility training in the blind because the problems of posture as well as the problems of mobility in the blind are not altogether different in kind from the same problems in the sighted. They are often different, mostly in degree.

Three basic concepts must be understood. 1) The influence of gravity, including the center of gravity; 2) the problem of swing and support: and 3) body rotation and the ground force (the frictional force that orients body movement).

Walking is an alternating loss and recovery of support with a series of displacements of various body parts in several planes. The brain, kept informed by the sense organs,directs the muscles to modulate the effect of gravity on body momentum. The center of gravity shifting during locomotion and body movement in relation to this are important.

The tendency of an individual to fall forward while ambulating depends upon several factors, 1) his body weight and 2) the distance of this weight anterior to his spinal column. However, the spine is not a rigid column, and the various distortions resulting from the forward pull of the load of the human body constitute the basic conditions inherent in all postural studies. The application of these simple facts in the evaluation and treatment of postural difficulties in the blind is obvious. When a student is leaning forward or backward, he is not bringing the center of gravity as near as possible to the supporting column of his spine. Leaning makes for imbalance. Of course, no one walks or stands perfectly straight, and there is a large margin of normality. The best choice is not the same for each individual.

Another biomechanical rule which must be obeyed, else we cannot remain upright, is that the supporting surface must be large enough to intercept the line of gravity of the body. This is well observed in the leaning tower of Pisa. It accounts for some of the wide-based gait seen in children first learning to walk, in individuals who are overweight, in pregnant women, and in anyone walking up a steep incline. The blind frequently walk with a wide-based gait to increase their effective supporting surface, so the center of gravity will fall within it, thus facilitating the upright stance.

The lower the center of gravity lies, the greater must be an arc which an unbalancing force must describe. Those of our students who walk with a bent knee gait are trying to lower their center of gravity to better maintain balance. However, anyone who stands or walks with flexed joints overloads his postural musculature. This is one of the reasons we like to have relaxed adequate posture; otherwise, standing and walking can be enervating.

In an alternating two-legged gait (bipedalism), the abandonment of the four legs as a means of support is conditioned upon elevation of the center of gravity, so that it lies over the supporting area of the two feet. The upper extremities shift and balance the trunk over the pelvis, and the arms swing, transferring momentum from one side to the other to prevent undue twisting of the body. If one walks with his arms straight to the side, the body has to twist to shift its weight. A tightrope walker uses an extension of his arms to transfer momentum so he does not have to shift at all. It could be very dangerous to shift even a little on a tightrope. Therefore, bipedalism is a combination of rhythmic forward propulsion and elevation of the body. In alternating bipedalism, only one lower extremity is used at a time, either as a propelling or restraining force. Propulsion is carried out by a leg placed on the ground in a backward diagonal direction at the moment the propelling leg is prepared to leave the ground. Start and stop, heel and toe.

A rapidly growing blind child is awkward in his movements because he has a poor discriminative appreciation of spatial relationship and is, therefore, totally oblivious of grossly faulty posture. He does not have the vocabulary or the experience. Even minimal conditions of malposture can eventually lead to pain and disability through incongruity in joint surfaces eventuating in overstretching and weakening of supporting ligaments with muscle weakness and fatigue. In addition to this, rather severe difficulties in orientation and mobility result from advanced postural problems. It has, in fact, been noted that even such minor movements as nodding the head and twiddling the fingers modify the performance of the lower limbs during locomotion.

Some of the problems commonly seen are as follows:

1) Dorsal round back (kyphosis, often due to a structural problem that cannot be helped by exercise. Sometimes bracing may be necessary.

2) Twisted back (scoliosis), yet another structural problem which may occasionally require operative correction.

3) Flat feet, often correctable through proper foot wear.

These three problems are mentioned because they illustrate the necessity of conducting an adequate orthopaedic examination of each blind student. Frequently, the correction of a common orthopaedic problem is all that is necessary to improve posture in the blind.

However, as noted before, much postural divergency is particular to the fact of blindness. Specialized techniques are necessary in the treatment of this pathology. Such methods aim at teaching the student the feeling of proper posture. Reflex splinting is sometimes used, as well as weighting of an extremity to correct the tendency toward imbalance. Apparatus which points the chin, exploiting the tonic neck reflex can be used to advantage. Exercise programs which increase proprioceptive awareness and avoid the enervation of static holdings are of value. The military stance is something to avoid. We strive for relaxed, functional posture. An expanded description of these as well as other techniques will be found elsewhere in this report.

Description of Research

Introduction

Mobility and orientation training is an essential aspect of any rehabilitation program for the blind. Effective mobility is usually a factor in job achievement, and vocational success is often directly proportional to a blind person's mobility and orientation skill. In order to live, work and compete in the sighted world, it is necessary that the blind individual travel and function at least as well as, if not better, than his sighted peer.

Effective mobility and orientation in the blind are predicated upon proper dynamic posture. Such posture is conditioned primarily by four influences; a) proprioceptive spatial orientation, b)postural reflex, c) body image, and d) perceptual cognizance. Good posture results in balanced coordination without strain and, therefore, is a goal to be sought, particularly by the blind who require the freedom of effective mobility.

The Illinois Visually Handicapped Institute was interested in determining and seeking solutions to the problems inherent in developing good dynamic postural habits and applying such knowledge to the mobility training of blind students.

The Illinois Visually Handicapped Institute is a unit of the Division of Rehabilitative Services in the Illinois Department of Children and Family Services. It is a rehabilitation center for those with less than 10% of normal vision who can benefit from its program. Since February 1965, the Institute has been housed in a modern building designed for this specific purpose at 1151 S. Wood Street, Chicago, Illinois.

Each applicant is given a medical, psychological, social and vocational evaluation and a schedule that meets his special needs designed. When entered as a student, a full range of courses and services are provided to meet the particular rehabilitation requirements of the individual. The study group was selected from these students.

Definitions

Verticality. The upright position. Perpendicular to the horizontal.

Postural Reflexes. Those reflexes which subserve the sense of position in space.

Vertical Concept. Judgment of the body's state of verticality.

Body Image. The mental "picture" one has of one's body in space.

Motor Perceptual Ability. Skill in perceiving and performing motor tasks.

Proprioceptive Spatial Orientation. Body orientation through the sense of joint position.

Blind. No light perception in either eye.

Severe Visually Impaired. A visual loss so severe as to be of no functional use for mobility.

Mobility. The ability of a blind or severely visually impaired individual to travel independently with the use of a cane.

Delimitations

This study was concerned only with those individuals: a)who demonstrated a postural defect and difficulty with mobility; b) who received in-residence services from the Illinois Visually Handicapped Institute during the period of this study; c) who were agreeable to participate in the study program; and d) who were under treatment (in the study) for a minimum period of three months.

The research did not investigate the physiologic basis for postural reflex mechanisms nor the psychodynamic background of body image conceptualization in the blind, except insofar as these matters directly and empirically affected posture.

Although concerned with the value of proper posture as a component of orientation, mobility and vocational potential, the research did not attempt the study of the role of posture in any specific vocational tasks or situations other than mobility.

Although concerned with developing techniques to diagnose and treat malposture and developing a practical program toward these ends, the research did not comprise a demonstration project of such a program.

Methodology

Design

This study utilized a program research approach to identify, diagnose and treat certain blind or severely visually impaired individuals suffering from a postural defect and having difficulty with mobility. The sample was selected from students of the Illinois Visually Handicapped Institute and demographic data collected on each individual.

A battery of psychometric tests was administered which included an intelligence test, a personality test, and special tests of motor perceptual ability.

A complete orthopaedic examination was given each subject with special emphasis on proprioceptive and kinesthetic status.

An examination of both static (sitting and standing) and dynamic (walking) postural patterns was conducted on each study subject.

A physiatric examination for diagnosis of conditions affecting posture (muscle contracture, ticks, blindisms, deformity, etc.) was given each subject.

A standard mobility evaluation was performed on each subject. Each student was programmed through motion picture recording of gait and posture status before, during and after diagnosis and treatment.

New treatment techniques applied to the blind and the multiple-handicapped blind student included postural exercise programs, special recreational techniques, and manipulative tactile apparatus. This project developed methods for demonstrating correct posture and mobility techniques to instructors for the blind, so that the findings might be directly applied in vocational rehabilitation programs for the blind. One method involved rating the degree of improvement by a panel of experts viewing serial movie sequences arranged in random order to arrive at a rating of :(a) unimproved; (b) improved; or (c) markedly improved.

The demographic, psychological and postural characteristics of these labeled categories was studied to discover relationships which might be of significant predictive value.

Sample

The sample population was composed of students receiving services from the Illinois Visually Handicapped Institute. The following criteria for selection of cases was adopted to ensure a sample population with the required characteristics.

1) Students medically described as having one or more postural defects.

2) Students demonstrating a skill deficiency in mobility.

3) Students willing to undergo a diagnostic study and participate in a treatment program.

4) Students remaining in the project for a minimum period of three months.

These criteria were applied to every applicant to the Illinois Visually Handicapped Institute during the study period. The number of applications each year average 150. The sample population consisted of forty-five students.

Each selected student received a diagnostic work-up as described below, and a medically appropriate treatment program was prescribed and implemented.

Photographic recording of posture and mobility performance was done before, during and following treatment. The motion picture records were reviewed to note the degree of improvement in mobility skill.

The students undergoing medical screening, diagnosis, and treatment for a period of three months comprised the same population for analysis of data.

Data Collection Procedures and Instruments

General demographic data was collected on all students and reported on Departmental Forms CFS-201, "Face Sheet", and CFS-202,"Application for Admission",Exhibits 1 and 2 respectively in appendix.

Diagnostic Phase - Mobility

Orientation skills were tested by asking the student to make certain degree and compass point turns on command while standing in place. The student's accuracy was noted and recorded in Section III, Parts A,B, and C, of the Mobility Evaluation Check List, Exhibit 3, in appendix.

Orientation stability and visual imagery was tested by the instructor's arm. The student was told which direction he is facing, that they will walk a pattern, and that the student will be asked how many directions they traveled, how many turns were made, and in which directions, what direction are they facing on completion of pattern, and can the student reproduce the pattern on paper with a pencil. The student's responses were recorded in Section III, Part D, of the Mobility Evaluation Check List, Exhibit 3, in appendix.

Memory, ability to reverse, sense of direction, ability to judge distance and walk a straight line was tested by giving the student the following directions:"Walk straight ten feet, turn right and walk five feet, turn left and walk five feet". These directions were repeated as often as necessary before the student began. The student's performance was noted and recorded. The student was then asked to reverse the direction and return to the starting point. The student's performance was noted and recorded in Section III, Part E, of the Mobility Evaluation Check List, Exhibit 3, in the appendix.

The student's performance in dealing with stairs was noted and recorded in Section IV of the Mobility Evaluation Check List, Exhibit 3, in the appendix.

Each student was observed during ambulation along a thirty foot track. The student was told to walk straight ahead. The examiner ordered the student to stop, turn around and walk to starting point. Gait deviations, such as veering, out-toeing, in-toeing, shuffling, head tilting, shoulder leading, or wide-based gait were noted and recorded under Section V of Exhibit 3, in the appendix.

Summary of performance, identifying any defects noted, was made and recorded along with the instructor's recommendations for a treatment program, if appropriate, under Section VI of the Mobility Evaluation Check List, Exhibit 3, in the appendix.

A letter grading (see Exhibit 4, in the appendix), based on the above noted evaluation was assigned to each student before and after treatment. These scores were correlated with other data, and conclusions as to effectiveness of treatment in each instance drawn.

Diagnostic Phase - Medical

Two plain observation mirrors were utilized for better evaluation of the students during posture examination. Each subject was examined while sitting and standing before the mirrors. Male subjects were dressed in gym shorts and females in shorts and a halter. All subjects were examined while barefooted. A standard orthopaedic postural examination was conducted in each instance. This examination included gross observation of posture and gait, strength of all major muscle groups, range of motion of all body joints, etc. (see Exhibit 5,in the appendix). Joint contractures were noted and measured. All postural deformities were similarly noted and measured. A neurological examination, including deep tendon reflexes, motor power and peripheral sensation with special evaluation of proprioceptive and kinesthetic abilities was made on each student (see Exhibit 5, in the appendix).

Each subject was tested on the verticalometer (Exhibit 6,in the appendix). This instrument is a four foot length of hollow aluminum tubing,attached through a ball and socket joint to a heavy wooden base. Measurements of vertical concept were taken with the right hand alone, the left hand alone, and finally with both hands by having the student place the rod "straight up and down". Measurements of verticalometer deviation in the anterior-posterior and lateral planes were taken with a bubble goniometer. This technique was used in quantitating conceptual postural error. Readings were noted and recorded.

Each student was observed during ambulation along a thirty foot track. In the case of the partially sighted subject, a blindfold was used for this part of the examination. Veering from the track was observed and recorded by degree. In cases where veering was present, wrist weights were applied either uni- or contralaterally,and their effect noted and recorded on a record sheet. A picture of a wrist weight can be seen in Exhibit 7, in the appendix.

Each subject underwent a complete physiatric examination. Such parameters as body image concepts, muscle tension, orientation, hand function, etc. were measured during this examination. A sample of the form used for recording the physiatric examination can be seen in Exhibit 8, in the appendix.

Diagnostic Phase - Psychological

The verbal portion of the Wechsler Adult Intelligence Scale was administered to each subject along with a Sentence Completion Personality Check List. The resultant intelligence score and personality rating was noted and recorded. Results were evaluated in conjunction with empirical observations and subjective appraisal of the student during clinical interviews, and a psychological diagnosis was recorded in narrative form.

Three special tests were designed to assess tactile form discrimination, tactile parallelity discrimination, and tactile turning discrimination.

Form concepts were assessed by noting the student's ability to perceive basic forms (triangle, Greek cross, circle,square) as measured by specially designed form-boards. These form-boards may be seen in Exhibit 9 in the appendix. Without any training, the student was asked to identify four different shapes in five different media, and correct verbal responses were noted and recorded. All forms were then placed in front of the student in mixed order with instructions to sort out similar shapes and make four piles of similar shapes. The number correct was noted and recorded on the Form Concept Instructions and Tally Sheet, Exhibit 10, in the appendix.

Parallelity concept was assessed by noting the student's ability to follow a set of nonparallel pieces of wood and report this lack of parallelity. This apparatus may be seen in Exhibit 9, in the appendix. The student was introduced to the apparatus while the strips of wood were in parallel relationship. One board was then changed in 10 degree intervals to a position at a 90 degree angle to the fixed board and returned. The student was asked to tactually study the relationship of the two boards at each point and verbally report their parallelity. Four trials were run and correct responses were noted and recorded on the Test of Parallelity Tally Sheet, Exhibit 11, in the appendix. Examiner's Instruction Sheet can be seen in Exhibit 12, in the appendix.

Turning concepts were assessed by noting the student's ability to accurately operate a free-wheeling turntable, capable of rotating 360 degrees, to which a marking device was attached. Degrees were marked off on a surrounding ring of paper. This device could be seen in operation by a student with an examiner looking on in Exhibit 9, in the appendix. The student was instructed to turn the turntable on command 45,90,180,and 360 degrees, both left and right. The number of correct turns (accuracy within plus or minus 5 degrees) was noted and recorded on the Turning Instructions and Tally Sheet,Exhibit 13, in the appendix.

Diagnostic Phase - Miscellaneous

A number of students were programmed through an adaptation of the Montessori Training Equipment as an aid in diagnosing and treating perceptual motor deficits. This apparatus provided an additional parameter for the measurement of motor status and its correlation with posture and mobility skills. This equipment can be seen in Exhibit 14, in the appendix.

An attempt was made to determine the degree and direction of the relationship between mobility skill and the results of performance on models designed to assess various perceptual concepts. A clarification of these inter-relationships will, hopefully,lead to 1) a better understanding of the perceptual-conceptual factors involved in mobility training; 2) a technique for predicting possible problem areas in mobility training; and 3) innovations in teaching techniques of mobility training.

Treatment Phase - Mobility

Each student was enrolled in the general orientation and mobility program of the Institute. The study group received additional instruction. Education in proprioceptive spatial orientation was approached first by demonstrating postural habitus through the use of a life-sized mannequin. Each student was given the opportunity of handling the mannequin, so that the various body and limb positions could be demonstrated kinesthetically, Exhibit 15, in the appendix.

Kinesthetic knowledge of body and limb positions was transferred to a proprioceptive spatial orientation through the use of a "wind tunnel". A large standing fan, flanked by portable wooden screens, was used to direct an air current on the student as, dressed in loose gym clothing, he was instructed to stand in the air current thus created. While in this location, the student was instructed in the assumption of a variety of postural stances. He also carried out any prescribed postural exercises while in the current of air. During this phase of his treatment program he was encouraged to verbalize the position of his body and extremities. In this manner, sensory input was increased, and the development of an acute awareness of posture and limb position during movement was accomplished. See Exhibit 16, in the appendix.

Treatment Phase - Medical

Those students diagnosed as having problems of malposture, significant enough to compromise efficient mobility, received appropriate orthopaedic and/or physiatric treatment techniques. These techniques included exercises, when indicated, Exhibit 17, in the appendix, and where a specific structural orthopaedic problem necessitated the use of restraints or braces, special apparatus was applied. See Exhibit 18 and 19, in the appendix. A physical therapist was employed to develop and apply special exercise techniques to meet the particular needs of each student.

Students demonstrating a deficit in balance and spatial sense underwent a progressive series of exercises performed on a trampoline. A physical education specialist was employed to develop and apply special exercise techniques to meet the particular needs of each student. See Exhibit 20, in the appendix.

Photography Recording Techniques

Recording of gait and posture patterns before, when one half (six weeks) through the program, and after the program was accomplished through motion picture photography. This evaluation consisted of having the student walk unaccompanied a distance of fifty feet back and forth in front of the camera and then (again unaccompanied) walk a similar distance to and from the camera. Voice commands were used to direct the student along these pathways. All photography was performed in the Department of Photography at the University of Illinois, College of Medicine (Exhibit 21, in the appendix).

Motion picture records, as above described, for each student in the study sample were collected, identified and placed in random order.

Two panels of three experts each reviewed these film sequences and labeled each sequence as to its proper placement in the chronological order in which it was taken. One panel was composed of mobility instructors for the blind, the other of specialists in physical therapy and postural training. Thus, the sum of the assessments of two separate disciplines was obtained.

Each expert made his judgment independently. The total number of correct responses of all six experts made, by correctly identifying the proper order in which each film sequence was taken for each student, with the improvement score for each student. Therefore, a perfect improvement score could be obtained by having all experts correctly identify the proper order of all three film sequences of one student. The maximum score would be three sequences times six experts, or 18.

The actual score for each student in the sample was noted and recorded. The distribution of scores was plotted and divided into three parts. Those receiving the lowest improvement scores were labeled "poor improvement" (C), those receiving middle improvement scores were labeled "moderately improved" (B), and those receiving the highest improvement scores were labeled "markedly improved" (A).

It was then possible to study the results in terms of these classifications. Demographic characteristics, performance on all diagnostic apparatus, and psychological traits were examined to discover relationships which might be of significant predictive value. The types of postural deviations which respond to treatment, as measured by improved mobility skills, were identified.

Physical Therapy Techniques

In order to achieve effective mobility, the blind student must have good posture and balance. In addition, his concepts of body image and basic orientation in space should be adequate and accurate. Within these areas, physical therapy can contribute to mobility training.

An evaluation must be made before physical therapy techniques utilizing only nonvisual cues or aids can be instituted to develop good posture and sensory awareness. Some of the physical therapy techniques currently in use and under investigation at the Illinois Visually Handicapped Institute in Chicago are presented here.

Evaluation

The accompanying form,which is currently being used for physical therapy evaluation, covers three basic areas: 1) physical characteristics and abilities; 2) gait; and 3) concepts of body image and orientation (Exhibit 8, in the appendix).

First, the evaluation form is used to test all physical or postural defects, such as head drop, abdominal protuberance, lordosis, or scoliosis. Any weakness or limitation of motion can be discovered through manual muscle testing, examination of joint range of motion, and muscle length tests. During these examinations the student's state of tenseness or relaxation is recorded, and his coordination and balance are tested.

Second, the student's gait is observed to determine whether it is wide-based and out-toeing, hesitant and shuffling, or propulsive and unsteady, and whether veering is present.

Third, an attempt is made to determine the student's concept of body image, primarily through questions concerning relationships of various parts of the body, verbal descriptions of body parts, and tests of his ability to perform accurate motions in response to simple commands.

A test is also made of the student's execution of turns. Finally, to assess his ability to acquaint and orient himself in strange surroundings, he is asked to perform activities such as pointing to the door he used to enter the room or finding an object located on a particular wall in the room. The number of attempts he makes, and the amount of additional assistance he requires to perform these activities, are observed and recorded.

With the exception perhaps of the tests for muscle strength and length, this evaluation is subjective and somewhat superficial. Rather than attempt to pinpoint very precise and detailed problems, the evaluation tries to establish broad and basic areas of difficulty which may then be approached not only by physical therapists but also by personnel in related disciplines.

Following the first evaluation and at intervals during treatment, the student's ability and progress are rated on a scale ranging numerically from one to five (Exhibit 22, in the appendix).

Treatment

After completion of the evaluation, a suitable treatment and training program is instituted. First, a general exercise program is established to fit the needs of each student and carried on daily in class under the supervision of the institute's Physical Education Department. This program is designed to provide adequate muscular ability, promote relaxation, and improve coordination.

Muscle Strength and Length

The most common areas of muscle weakness include trunk,neck, and hand musculature. Limitation of motion is often present in the scapular and back regions and at the hip and ankle. Conventional exercises are used to correct these problems.

Relaxation

To help reduce tenseness and rigidity, especially of the upper extremities, the student first learns voluntary contraction and relaxation of large muscle groups in connection with breathing. Then he proceeds to isolated and reciprocal motions which call for contracting one part while maintaining relaxation in the rest of the limb or body.

Coordination

Coordination is very often a problem for the blind child, possibly because he does not have opportunities to participate in activities which promote natural development of coordination. Therefore, some time is devoted to activities such as rolling, crawling, and balancing on all fours.

To aid in improving basic coordination and development, the institute recently began using the Exer-Cor^R machine which is designed specifically for cross-patterned creeping exercises. Assuming the crawling position, the student places his hands and knees on four small pads which are on tracks, and learns to pattern,incorporating head movement with his arms and legs (Exhibit 23, in the appendix). The machine's construction requires the student to use his own muscle strength, but he is able to move only in the desired pattern. Straps and other devices help hold the hands and legs in place,if necessary, and the instructor stations himself behind or in front of the student for assistance in the beginning stages.

To improve strength and coordination of the hands, the student is taught reciprocal hand movements such as alternate opening and closing of fists. He also works at the hand activities table which, by use of pulleys and weights, provides resistive exercises for even the smallest muscles in the hands and fingers (Exhibit 24, in the appendix). Other devices which are used include exercise putty, various types of grippers, and wrist and finger rollers.

If the blind child has any other disability - scoliosis, postpoliomyelitis, or cerebral palsy - specific, conventional exercise programs are incorporated into the total treatment.

Postural Training

When the general exercise program is under way, actual postural training is given. Success has been achieved with a group of exercises adapted from exercises previously used for patients with low back pain and weakness. These exercises are based on a reduction of the curve in the lower back, which is accomplished by contracting the abdominal and gluteal muscles that result in a flat back. The student learns not only to perform this contraction as an isolated activity, but also to maintain that posture while performing other motions and in connection with breathing.

These exercises are taught to a group of five or six students.

The group atmosphere is conducive to more discussion and experimentation and, therefore, to a meaningful learning experience. In addition, postural exercises lead into the control of trunk muscles, which plays an important role in balance.

Gait Training

Another phase in postural rehabilitation is the correction of faulty walking habits. This phase involves a variety of techniques for training of heel-toe gait, maintaining a stable, narrow base of support, eliminating out-toeing or head drop, maintaining relaxed upper limbs, and improving tracking. Most of these defects can be approached much as they would be in a sighted person. However, some nonvisual aids can be used for such gait training.

The treadmill (Exhibit 25,appendix) is useful for teaching heel-toe gait because it cannot be operated in any other manner, and because the narrow width of the treadmill belt limits the base of support.

Another device used to teach correct positioning of the feet is the slant board (Exhibit 26) or inversion board (Exhibit 27). Because the student walks along the sloping board with his toes touching the raised center strip, out-toeing is discouraged.

A soft cervical collar may occasionally be used as a temporary reminder to discourage head tilt or drop. This measure is designed to draw the student's attention to a postural defect he cannot see.

To help promote a more natural relaxed arm swing during gait, the crook of a long cane may be placed in each of the student's hands. The therapist grasps the opposite ends of the canes and walks in tandem. The student projects his arm swing to the therapist's as they walk (Exhibit 28).

Weighted wristlets on the contralateral arm are also used at times to correct excessive veering in gait.

For the other two areas of the physical therapy training program, body image and orientation training, the techniques used must of necessity be newer and more unusual than any others discussed. The blind child needs a great deal of special help in these areas in order to develop a sound mental picture of himself, of the world around him, and of his relationship to that world. The institute is currently experimenting with several techniques developed for this purpose.

Body Image

One of the greatest aids in teaching the concepts of body image is the full-sized, articulated mannequin. First, the student uses his tactile sense to explore and learn something about the human body and the relationships of its parts. Later, through questions, demonstrations, trial and error,and imitation, the student begins to learn not only what his own body looks like but how, where, and why it moves as it does.

Hopefully, in the future someone will design a life-size figure which will be even more realistic in regard to texture,temperature, joint structure, and other features; perhaps a figure like those now used in some medical and nursing schools for training in anesthesiology and artificial respiration. However, even a storewindow mannequin provides a beginning.

Orientation

To help develop the student's orientation to his surroundings, a fixed object, such as a wall, is initially used. Against the wall he performs motions such as flexion and abduction of the arm at the shoulder joint, and abduction and rotation of the leg at the hip joint. The emphasis is on accuracy. Instruction in making accurate turns also begins at the wall,using the relationship of the body to the wall to determine 90-, 180-,and 360-degree turns. The 90-degree turn is stressed because of the importance of accurate turns in mobility. For this purpose, two walls may also be used; the student places the entire back of his body against the wall being trailed by the hand or cane in order to make an exact 90-degree turn.

Later, less fixed clues are sought, such as the resistance of the body to a strong wind. To gain this effect, a floor fan on a relatively tall base and two portable walls are used to form a type of wind tunnel. Again, the student learns joint motions and turns through wind resistance on a particular body part or surface to determine accuracy. Initially, the fan's highest speed is used, and the speed reduced as the student improves. Eventually, of course, the student must proceed to similar activities without any aid.

To utilize better the student's sense of touch in orientation training, a carpeted, wooden tunnel was devised to shrink his surroundings, so to speak, to a point where he would be able to come in physical contact with a larger area at one time (Exhibit 29). The tunnel is three feet square, with three separate straight sections of nine feet each, and two curved corner sections. This construction allows the therapist to arrange the tunnel in several shapes.

The students use the tunnel in groups. They are told only that they will be crawling through a structure which is completely safe. Each student is introduced to the entrance of the tunnel,and then placed on his knees and allowed to make his way through it, silently gathering as much information as possible about it.

After all the students emerge, the group decides what the object is, what it is made of, how large it is and of what shape, how many parts and corners it has, and so on. This exercise usually provokes considerable response and enthusiastic discussion. The students attempt to picture the tunnel in their minds and then to relate some of the ideas and concepts they have learned to everyday objects and experiences. Later, the students who judged incorrectly or had difficulty grasping some concept are taken back to the tunnel and given a chance, with assistance if necessary, to learn the correct answers. The shape of the tunnel may then be changed and the group allowed to try again.

This activity has proved useful not only to the student's learning program, but also to alert the therapist to specific concepts which the students lack or find difficult.

Special Clinical Report

Postural Compensation in the Motor-Handicapped Blind

Vision is such a stunning sense that its use for postural orientation all but completely dampens other sensory modalities. If the body is to attempt postural compensation in the face of visual loss, input through remaining senses must be abundant enough to enable the subject to successfully contemplate his stance and movements.How can this be accomplished? Examination reveals that not only the solely biomechanical and psychological factors, but the perceptive variables as well are important, e.g., blindness is often only one aspect of a larger neurological loss, motor perceptual disability also being present. This is particularly true in cases of congenital blindness in which marginal brain damage has occurred. Thus, postural training should never be conducted in a void. Exercises are performed best with reference to a vertical surface, such as a wall. Sensation of limb position in space is enhanced by exercising in front of a large fan. The correct "feel" of upright carriage can be learned only through repeatedly enforcing the engram gained by such proprioceptive feedback. The use of tumbling, trampoline drill, or any other activity designed to increase kinesthetic input is of value in laying the ground work for postural refinement.

Although the kinesthetics of ambulation have not yet been fully elucidated, it is apparent that the difference between abnormal and normal gait patterns is one of degree rather than kind. The same mechanisms for security and balance which the blind are required to use can be noted in the sighted during periods of normal growth, unusual stress, temporary loss of vision, or other situations in which the apparatus of secondary posture control is employed. In this regard, wide-based out-toed gait is seen in the sighted infant taking his first steps, as well as the sighted adult attempting to maintain balance on a steep incline. Even so-called "blindisms" are not peculiar to the blind. Head rocking is not uncommon among otherwise normal infants where it is used as a self-stimulatory mechanism to "keep in balance" psychologically as well as physiologically. It is of interest to note that this automatism is often employed at bedtime in the dark. The use of such techniques by the blind, as by the sighted, may be effective, but their cost in energy to the organism makes them inefficient in the extreme.

The postural problems of the partially sighted are often as serious as those of the blind and partially deaf, particularly when sight or sound perception is only unilaterally present. Such individuals tend to point with the functioning organ and usually veer to that side. During rehabilitation blindfolding the sighted eye may be necessary, at least in the initial phase of mobility training. Occluding one ear has also been of value in correcting a tendency to veer.

Many factors are involved in postural compensation,and they are often difficult to measure. For instance, the proper use of the Hoover long cane involves a cross-patterning of body movement. Several of our multiply handicapped pupils have been taught cross-patterning and crawling before being introduced to the cane. Such preliminary instruction seems to facilitate the early phases of cane training.

A complete orthopaedic and neurological evaluation, including an examination of stereognosis, position sense, and tactile kinesis, can offer clues to the particular needs of each student. In meeting these needs, special techniques must be developed and applied, particularly when blindness is compounded by motor loss. In these instances, rehabilitation is at best difficult, but meeting the challenge is often rewarding.

A group of case reports describing some postural problems seen in the motor-handicapped blind follows. Each summary illustrates the nature of the problem and its treatment, followed by comments.

A twenty-three year old blind female had a variety of orthopaedic defects. She was the product of a normal pregnancy and delivery and had met her motor milestones at the average times. But, when she was twenty months old, she sustained a brain injury which left her a spastic quadriplegic and totally blind.

She had dealt with her blindness and motor problems reasonably well, having completed high school at a nonspecial facility. Numerous surgical procedures performed to increase stability in her lower extremities and extensive attempts at physiatric rehabilitation proved only moderately successful. A tendency toward recurrent depressions added to her organic problems.

Examination revealed a typical spastic gait with mild to moderate spasticity in the upper extremities. She had difficulty with balance and walked with the aid of crutches. A progressive spinal curvature complicated her postural problems. Hip flexion contractures were severe, but the feet were plantigrade. There was an increase in lumbar lordosis as well as adduction and internal rotation contractures of the right hip. A lack of supination of the right wrist was also noted. Neurological examination revealed good tactile localization, stereognosis, position sense, graphesthesia, weight perception, vibratory sense, and two point discrimination. No gross loss of motor perception could be detected.

Gait and ambulation training and rehabilitation exercises, including stretching of the flexors of both hips, were initiated under the supervision of a physical therapist. Initially, it was necessary to drill the student in creeping, crawling, and cross-patterning. Subsequently, appropriate postural exercises were utilized which were performed in front of a large fan. Emphasis during her training was placed on balance and contracture stretching in the lower extremities. She progressed from two-crutch walking with one hand on a supporting rail.

Close observation during training revealed that hip adduction and internal rotation deformities on the right were seriously impairing her gait, and a surgical operation was performed to amend this. She has continued to improve since this surgery.

Appropriate orthopaedic evaluation and attention can prove of value in the rehabilitation of the motor-handicapped blind student. In this case, a series of surgical procedures, combined with an intensive program of physical therapy, expedited the patient's motor rehabilitation. Good balance and coordination were major problems. Emphasis was originally placed on mat exercises. Later, a sequential program of balancing on all four limbs, creeping crawling, and,finally, standing balance exercises were followed. Kinesthetic input was enhanced by performing the exercises in front of a large fan.

A thirteen year old congenitally, totally blind female had a moderate spinal curvature with increased lumbar lordosis. She had a severe bowing of the knees, and anterior curvature of both thighs and legs. Her trunk was foreshortened, her fingers reaching approximately to the level of her knees. She had a history of multiple fractures of the lower extremities during early childhood, all of which healed without incident. X-rays were taken which revealed the stigmata of osteogenesis imperfecta tarda. The postural problem was essentially one of balance of the trunk and upper limbs over the lower extremities.

A standard program of postural exercises, mobility, and orientation training was initiated. Because of her bony deformities this patient progressed more slowly than the average, but she was bright, alert, and well motivated, and eventually was able to travel as well as her fellows.

Most of the deformities noted in this case were attempts to compensate for structural abnormalities in the back, hips,and lower extremities. No attempt was made to correct these deformities surgically because the patient's segmental balance was in compensation and she was functionally stable.

Because of the anterior bowing of her thighs and legs, her weight bearing line was forced posterior to her knees,and her back condition represented an effort to maintain the erect position. It is important to note that in a rehabilitation program functional restoration should supersede cosmetic correction. Efforts to obtain better appearance alone often result in poorer performance.

A twelve year old totally blind female had spastic quadriplegia. She had undergone numerous orthopaedic procedures to gain stability about the feet and ankles. She could barely stand, using a heavy cane in her left hand. Some left torso shift was present,and flexion contractures of the elbows, wrists, hips, and knees were noted. There was severe pes planus with ankle valgus.

This patient had no concept of verticality. She walked with a hesitant wide-based gait. Her balance was tenuous. Since she required a heavy stick for stability while walking, she could not use the long cane.

Balance exercises were prescribed. Ambulation was started with the patient tethered to the instructor with a light belt. A modified light cane which was short enough to provide stability was provided. Gradually less support was required. No effort was made to correct her posture beyond what was necessary for effective ambulation.

The "jump position" and wide-based gait were maintained in this student as they contributed to stability. Balance exercises, combined with gradual weaning from support,enabled her to eventually discontinue the use of a heavy cane and to use a long one effectively.

A nineteen year old congenitally,totally blind male had been diagnosed as a spastic paraplegic. His gait was characterized by spastic circumduction. His posture was compromised by intoeing and a wide-based stance. There was difficulty with balance,and an increase in lumbar lordosis with a flexible torso shift was also noted. His tendency to veer to the right when tracking was corrected by placing a weight on the left upper extremity. Bilateral hip flexion contractures were present. The student could not stand on one foot alone, and walking on the heels and toes was impossible because of foot deformities. Neurological examination failed to reveal motor perceptual deficit.

A manual muscle examination was performed and appropriate strengthening exercises, as well as balance drill and contracture stretching, were started. The student was given a regimen of physical therapy and physical education.

Frequently, the standard mobility program must be modified to accommodate a student's disability. An accurate manual muscle examination can reveal specific motor loss and aid greatly in structuring a rehabilitation program. Veering tendency can often be corrected by weighting on an upper extremity.

A seventeen year old totally blind male had neurofibromatosis and a secondary optic nerve tumor. He was overweight and had the obvious stigmata of his disease including multiple skin lesions and neurofibromata of the superficial nerves. He was very clumsy in his gait and posture, and walked with a heavy out-toed gait. A mild dorsal kyphos was present. Psychometric testing revealed that he was functioning intellectually at approximately the seventh grade level.

Postural exercises were initiated and as he had some difficulty with motor learning tasks, special tactile learning techniques were employed. These utilized Montessori instruction and emphasized gross form recognition and manipulation. A program of trampoline drill was begun. Through these measures the patient improved. His posture has become more acceptable and his gait less clumsy.

Basic form recognition and manipulation provide excellent preparation for the performance of gross motor tasks. The Montessori apparatus and techniques can help to develop such skills in the blind. The balance requirements of trampoline drill offer a kinesthetic experience which tends to exercise and refine motor perceptual abilities.

A sixteen year old male had a history of congenital, total blindness. In addition, he had been given little opportunity to move independently or, in any way, to experience the world around him. Neurological examination revealed a congenital cerebral defect involving the occipital cortex and certain sensory centers producing a postural ataxia. The student engaged in frequent lateral head rocking with hyperkinetic motions in all extremities. He moved very rigidly and was constantly off balance. A mild mid-thoracic scoliosis was noted. The gait was rigid and wide-based, and marked pes planus was present. His head was held turned toward the left with the chin elevated, and there was gross muscle wasting in all extremities including the small muscles of the hands.

A full program of posture training, including relaxing exercises and standard physical education drill, was initiated. A variety of sensory stimulating activities, including the use of a full-sized mannequin for demonstration of body parts and position, were programmed. The student continues on this regimen and has shown progressive improvement.

The proper treatment of sensory deprivation is the provision of lavish stimulation. All manner of kinesthetic experience will be offered this student. As his balance and mobility skills improve, more refined techniques will be used. These may include barefooted ambulation on textured runners as a supplement to standard mobility training. The use of a full-sized mannequin has proved of value in this case in helping the student structure an appropriate body image.

The postural apparatus in the blind is severely compromised by motor disability. However, rehabilitation can still be effective through the use of special techniques suitably tailored to the requirements of the individual student.

Each of these cases illustrates certain of these needs. Many orthopaedic and neurological diseases can be complicated by blindness (e.g. gargoylism, Friedreich's ataxia, Marfan's syndrome, etc.) and blindness can compound any motor problem. The therapy of malposture requires clarification of the basic cause(s) of divergency (biochemical, psychological,perceptual, etc.) with treatment aimed at functional correction. In this way, optimal rehabilitation can be accomplished.

Results

General Remarks

Total population was 45 subjects, except for psychometric testing where total population was 41 subjects.

Table 1 details the diagnostic/treatment matrix.

There was no significant correlation between age, sex,or intelligence quotient, and any of the improvement or achievement scores.

Chart 1 illustrates improvement in posture, evaluated on the postural physical therapy scale and correlated with final improvement score.

Chart 2 illustrates improvement in mobility, evaluated on the mobility improvement scale and correlated with final improvement score.

Charts 3,4 and 5 illustrate the three psychometric tests; 1) gross form recognition; 2) manual transcription of various arcs of a circle; and 3) parallelity recognition) correlated with final improvement score.

Chart 6 illustrates degree of improvement in postural therapy, correlated with degree of improvement in mobility.

Scoring Key for Data Charts

Posture Therapy

S - Same score before and after therapy.
Numbers represent improvement in scores before and after therapy.

Ex. Rating Scale: 1 - 5
Score: Before After
3 — 1 — 4
1 (improvement)

Mobility

S - Same score before and after mobility training.
Numbers represent improvement in scores before and after mobility training.

Ex.Rating Scale: Poor,Fair,Good,Excellent, Superior
Score: Before After
P — 2 — G
2 (improvement)

Psychometric Tests

1 - Raw scores on a scale 1 - 5

2 - Numbers represent rating scale

Raw Score	Rating	
25 - 39	1	(low)
40 - 54	2	
55 - 60	3	(high)

Chart 1 - Improvement in Postural Therapy

Correlated with Final Improvement Score

Of 20 students with a final improvement score of A:

1) Five students (25%) did not improve in postural therapy. However, it is significant that of those five, four already had achieved a high score in postural therapy (score of 4- or above). Only one student remained the same with a low score.

2) Eight subjects (40%) improved one third, but one half of these already had high scores in therapy (4- or above).

3) Seven students (35%) improved significantly.
   Five students improved two thirds.
   One student improved one.
   One student improved one and one third.

Data concerning students with a final improvement score of B is not statistically significant because the sample (eight) is inadequate. However, four improved and four remained the same. Three of those not improving were already at a high graded level in posture therapy.

Of 17 students with a final improvement score of C:

1) Seven students remained the same in postural therapy. Of these, five were already at a high level (4- or above).

2) Five students improved one third. One of these was already at a high level.

3) Five students made significant improvement.
   Four students improved two thirds.
   One student improved one.

Of the total subjects (45) tested:

1) Sixteen students remained the same. Of these, twelve (75%) already had high scores in postural therapy.

2) Fourteen students improved one third. Five of these were already at a high level in postural therapy.

3) Fifteen students (33-1/3%) made significant improvement.
   Nine improved two thirds.
   Three improved one.
   Three improved one and one third.

Thus, all students either improved or remained the same in postural therapy. Of those remaining the same, 75% were already at a high level.

Chart 2 - Improvement in Mobility

Correlated with Final Improvement Score

Of 20 students with a final improvement score of A:

1) Five (25%) remained the same. It is significant that of these four were at a poor level.

2) Twelve (60%) improved one.

3) Three (15%) improved two.

Eight students had a final improvement score of B. Data here is too scant for statistical significance.

Of 17 students with a final improvement score of C:

1) Eight students remained the same, but of these, six began at a poor level.

2) Seven improved one.

3) Two improved two.

Of the total number (45) tested:

1) Fifteen students (33-1/3%) remained the same. Eleven of these were at the poor level.

2) Thirty students (66-2/3%) improved.
   Twenty-three improved one.
   Seven improved two.

Thus, approximately 50% of those with original poor level mobility scores tended to remain the same. The remainder improved after treatment.

Chart 3 (Psychometric testing of gross form recognition) and Chart 4 (Psychometric testing of manual transcription of arcs of a circle) illustrate no significant correlation of these tests with final improvement scores, nor was there any correlation, positive or negative, of these several psychometric examinations with any postural or mobility parameter of achievement score.

Chart 5 - Psychometric test of Manual Parallel Discrimination, correlated with Final Improvement Score

Of 18 students with a final improvement score of A:

1) Four had a rated score of one (low).

2) Three had a rated score of two.

3) Eleven had a rated score of three (high).

Of eight students with a final improvement score of B, data is of minimal significance.

Of 15 students with a final improvement score of C:

1) Six students obtained a rated score of one (low).

2) Three students had a rated score of two.

3) Six students had a rated score of three (high).

These results show a significant correlation between the ability to manually ascertain parallelity and the final improvement scores of the students. Thus, this psychometric examination may have predicitive significance.

Chart 6 - Improvement in Postural Therapy

Correlated with Improvement in Mobility

Of 15 students remaining the same in mobility:

1) Five remained the same in postural therapy. These were already at a high level in therapy.

2) Five improved two thirds in therapy.

3) Three improved two thirds in therapy.

4) One improved one in therapy.

5) One improved one and one third in therapy.

Of the 23 students obtaining an improvement score of one in mobility:

1) Eight remained the same in therapy. Six of these students

were already at a high level in therapy (4- or above).

2) Seven students improved one third in therapy. Of these, four were already at a high level.

3) Four students improved two thirds in therapy.

4) Two students improved one in therapy.

5) Two students improved one and one third in therapy.

Of seven students obtaining an improvement score of two in mobility:

1) Three students remained the same in therapy. All three were already at a high level in therapy.

2) Three students rated an improvement score of one third in therapy. Of these, one was already at a high level.

3) One student improved two thirds in therapy.

Thus, 28 of 45 students tested demonstrated a positive correlation between improvement in mobility and improvement in postural therapy.

Discussion and Implication of Results

As noted, analysis of data fails to indicate correlation between age, sex, or measured intelligence quotient, and any variable, including postural therapy improvement, mobility improvement or final improvement score. We also note that the degree of orthopaedic or neurological deficit does not necessarily affect improvement potential. The majority of students (29 of 45) showed improvement in posture under treatment. Of those not improving (16), 75% had high postural therapy scores to begin with. Approximately two thirds of all students tested improved in mobility, and approximately 50% of those with original poor level mobility scores improved after treatment. Almost two thirds of all students tested showed a positive correlation between improvement in postural therapy and improvement in mobility.

Additionally, although lack of correlation between psychometric tests 1 and 2 with postural therapy, mobility, or final improvement scores was disappointing, it was encouraging to note the high positive correlation of psychometric test 3 (manual parallelity discrimination) with the final improvement score. This test may, indeed, have a predictive and prognostic value in predetermining those students who might be expected to excell in a postural training-mobility program, such as described.

The implications of these results are simply stated.

1) Postural training contributes to mobility skill.

2) Even those students with a low intelligence quotient and severe orthopaedic and/or neurological deficits can be programmed successfully through postural training with subsequent improvement in their ability to orient and travel.

The parameters of posture can be utilized in the training of mobility skills in the blind. Improvement in these skills can be clinically evaluated through the methods described.

Orthopaedic evaluation and postural therapy can play a positive role in the total rehabilitation of the blind, thus significantly contributing to vocational potential.

Table 1

Diagnostic Treatment Matrix

No.	Init.	Age	Sex	Ortho-Neuro-Findings	Therapy		Mobility		IQ	Psych.			Improvement Score
					B	A	B	A		I	II	III	
1.	T.A.	27	M	Left torso shift. Wide-based gait. Hamstring tightness. Right veering. Posterior deviation on verticalometer. Poor stereognosis and shape discrimination. Slight imbalance standing on each foot.	2	3	P	P	76	1	29	148°	12 - A
2.	F.B.	26	M	Moderate kyphos. Hesitant gait. Tight hamstrings. Decreased sensation in soles. Diabetic neuropathy. Absent reflexes in lower extremities.	4	4	F	G	97	3	60	175°	6 - C
3.	B.F.	40	F	Poor orientation. Points with left ear. Mild ataxia.	4	4	P	P	79	1	60	170°	11 - B
4.	C.F.	23	F	Pes planus. Valgus knees. Cautious gait. Wide-based. Veers right. Posterior verticalometer error. Head droop. Tense.	3	4	P	F	91	1	53	130°	8 - C
5.	W.G.	20	M	Loose joints. Flat feet. Poor orientation. Very tense. Head droop. Mild kyphos. Tight hamstrings. Ankle clonus bilaterally. Discoordination. Tight Achilles. Slight imbalance.	2	3	P	F	107	2	52	135°	11 - B
6.	B.G.	18	F	Excellent postural patterns with no neurological or orthopaedic problems of note.	4	4	G	E	114	3	55	176°	12 - A

No.	Init.	Age	Sex	Ortho-Neuro-Findings	Therapy		Mobility		IQ	Psych.			Improvement Score
					B	A	B	A		I	II	III	
7.	W.K.	20	M	CSP. Bilateral triple arthrodesis. Tendon transfers and osteotomies hips. Intoeing. Kyphos. Spastic circumduction gait. Torso shift with increased lordosis. 30° hip flexion contracture. Lurching gait. Moderate anterior verticalometer deviation. Tandem gait impossible and heel and toe walking impossible. Atrophy of lower extremities.	2	3+	P	F	106	3	55	160°	11 - B
8.	J.M.	27	F	Wide-based outtoeing gait. Pes planus. Obese.	2+	2+	P	P	118	2	55	135°	4 - C
9.	M.P.	18	M	Pes planus. Propulsive gait. A.P. rocking.	3	3	G	E	97	3	55	177°	11 - B
10.	J.R.	19	M	Partial loss. Good posture and no neurological deficit.	4	4	G	S	-	3	60	178°	13 - A
11.	B.S.	18	F	Poor balance. Hyperreflexia. Right torso shift. Head drop. Mild kyphos. Pes planus. Rigid gait with small hesitant steps and wide-based with outtoeing. Imbalance and tension.	2	3+	P	F	89	1	55	157°	10 - B
12.	W.S.	26	F	Obese. Genu valgum. Mild kyphos. Slouching. Mild pes planus. Slight veering to right. All deep tendon reflexes decreased.	4	4	G	E	69	5	46	170°	14 - A
13.	V.S.	53	F	Ataxic gait secondary to cerebellar damage. Right hypoactive reflexes upper and lower extremities. Poor right heel to knee test. Finger to nose test (left worse than right) pos Unsteady gait with imbalance.	4	4	F	G	89	2	60	175°	7 - C

No.	Init.	Age	Sex	Ortho-Neuro-Findings	Therapy		Mobility		IQ	Psych.			Improvement Score
					B	A	B	A		I	II	III	
14.	D.F.	25	M	Left tilt and torso shift. Mild pes planus. Left verticalometer error with right and both hands. Veers to left. All reflexes decreased. Decreased tandem gait and decreased balance.	4	4+	G	S	108	0	60	170°	16 - A
15.	P.S.	29	M	Slight imbalance. Decreased external rotation hips with positive Faber. Slight right veering. Dupuytren's contracture palms.	4	4+	F	G	121	2	60	180°	2 - C
16.	J.H.	45	M	Acromegaly. Severe kyphos. Severe imbalance. Slow hesitant gait. Bunions. Hammertoes. Severe pes planus.	3	3	P	P	-	-	-	-	9 - C
17.	W.S.	19	M	Left head tilt, right hip elevated secondary to left thoracic right lumbar,severe, rigid scoliosis. Poor graphesthesia. Poor weighing perception. Fair balance. Left anterior verticalometer deviation of 15° in each direction when measured with right, left, and both hands. Poor body concepts.	2+	3	P	F	77	0	50	120°	16 - A
18.	D.C.	20	F	Obesity. Poor tandem gait. Pes planus. Poor concept of joint motions, poor body concepts.	3	3+	P	G	78	1	53	153°	11 - B
19.	M.B.	21	M	Decreased right Achilles deep tendon reflex.	4+	4+	F	E	75	1	60	130°	12 - A

No.	Init.	Age	Sex	Ortho-Neuro-Findings	Therapy		Mobility		IQ	Psych.			Improvement Score
					B	A	B	A		I	II	III	
20.	R.H.	17	M	Severe sensory deprivation. Postural ataxia. Cannot comprehend vertical concept. Left torso shift. Head tilt to left with chin up. Cannot stand on each foot alone. Precarious balance. Wide-based gait. Rigid, small steppage. Right thoracic left lumbar scoliosis. Pectus excavatum. Pes planus. Tight knees. Defect in stereognosis. Hyperactive reflexes. Lateral head rocking. Inverted hips with valgus subluxans. Hyperkinetic motions in both upper and lower extremities. Gross muscle wasting. Rigid back. Poor body concepts.	2+	3+	P	P		0	27	138°	9 - C
21.	A.K.	23	M	Pes planus.	4+	4+	G	E	120	5	60	128°	4 - C
22.	M.L.H.	21	F	Right eye pointing. Pes planus. Verticalometer deviation of 10° to left when measured with right, left, and both hands. Poor body concepts.	4-	4	G	E	100	4	58	83 °	13 - A
23.	R.B.	20	F	Mild kyphosis. Fair balance. Poor tandem gait. Mild talipes equinovarus, left. Tight right Achilles with atrophy right calf, and shortening right foot, and shortening below knee.	3+	4-	G	S	96	2	60	130°	5 - C
24.	A.M.	24	M	Poor gait and balance. Poor tandem gait. Poor heel and toe walking. Pes planus. Slight veering to left.	3	4-	G	G	125	3	47	150°	4 - C

No.	Init.	Age	Sex	Ortho-Neuro-Findings	Therapy B	Therapy A	Mobility B	Mobility A	IQ	Psych. I	Psych. II	Psych. III	Improvement Score
25.	K.M.	18	M	Poor balance. Poor tandem gait. Right thoracic left lumbar scoliosis. Pes planus. Verticalometer deviation of 20° posterior and 5° to right when measured with right hand. Poor body concepts.	3	4-	P	F	76	0	25	128°	13- A
26.	S.D.	19	M	Elevated left shoulder. Poor balance. Poor heel and toe walking. Poor tandem gait. Left head tilt. Pes planus. Slight veering to left. Finger to nose test poor on right. Congenital deformities of fingers. Facial asymmetry. Webbing of toes. Verticalometer deviation of 10° anterior when measured with left and both hands. Poor body concepts.	3-	3	F	G	75	0	53	173°	13 - A
27.	E.S.	19	M	Poor tandem gait. Stiff balance. Cleiodactylism fifth fingers. Verticalometer deviation 15° anterior when measured with left hand. Poor body concepts.	3	3+	F	G	100	1	53	158°	16 - A
28.	R.W.	48	F	Obese. Pes planus. Veers to right.	4	4	P	G	98	0	45	163°	10 - B
29.	E.W.	58	M	Toe amputation for diabetes. Poor balance. Poor heel and toe walking. Poor tandem gait. Pes planus. Tendency to veer. Fair spatial localization. Reflexes decreased in lower extremities. Two point discrimination poor. Verticalometer deviation of 15° to left when measured with right hand, 10° anterior when measured with left hand.	4-	4	F	G	100	4	57	170°	14 - A

No.	Init.	Age	Sex	Ortho-Neuro-Findings	Therapy		Mobility			Psych.			Improvement Score
					B	A	B	A	IQ	I	II	III	
30.	B.M.	21	M	Verticalometer deviation of 5° anterior when measured with right hand and 10° anterior when measured with left and both hands.	4-	4-	F	F	125	4	56	118°	10 - B
31.	M.E.C.	19	F	Fair spatial localization. Intellectually poor. Stereognostic recognition. Verticalometer deviation of 15° posterior and 10° to the right when measured with right and left hands, and 20° posterior when measured with both hands. Poor body concepts.	2+	3-	P	P	56				7 - C
32.	W.M.S.	41	F	Decreased Achilles tendon reflexes. Poor two point discrimination. Verticalometer deviation of 25° anterior when measured with right hand, 35° anterior with left hand, and 40° anterior with both hands. Poor balance.	3+	4-	P	P					12 - A
33.	L.S.	29	M	Negative.	4+	4+	G	E	98	3	60	143°	9 - C
34.	P.L.	31	F	Thoracic kyphosis. Pes planus. Veering to right. Decreased range of motion right glenohumeral joint with frozen right shoulder. Poor weighing perception. Hyperesthesia. Absent patellar and Achilles reflexes. Decreased two point discrimination. Verticalometer error of 20° anterior when measured with left and both hands.	4+	5-	F	G					15 - A

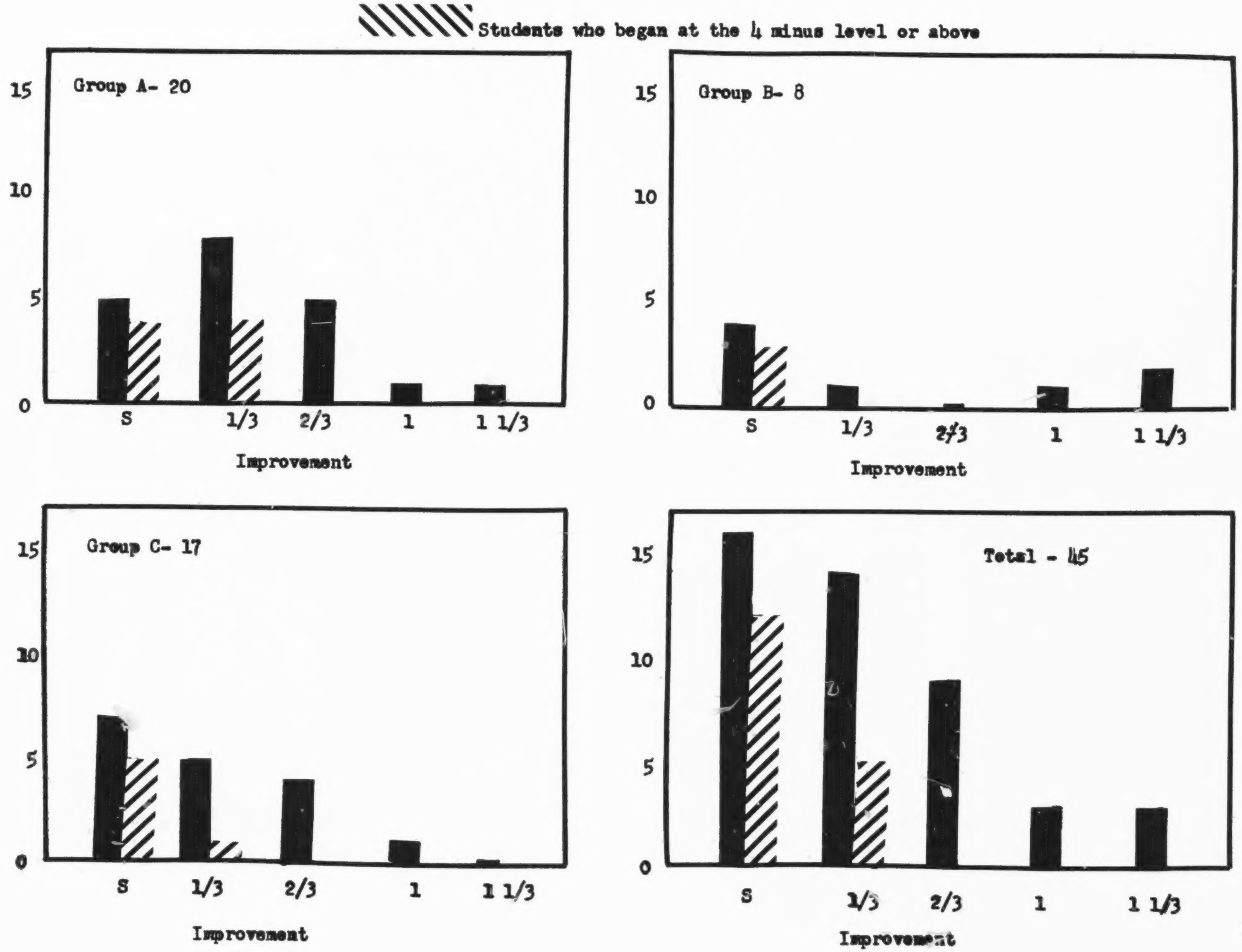
No.	Init.	Age	Sex	Ortho-Neuro-Findings	Therapy B	Therapy A	Mobility B	Mobility A	IQ	Psych. I	Psych. II	Psych. III	Improvement Score
35.	B.W.	24	F	Gross spasticity. Previous history of operations, right knee and left heel. Positive Romberg. Poor balance. Poor heel and toe walking. Poor tandem gait. Drags right foot. Pes planus. Slight ataxia. Spasticity in all major joints. Heel cord contracture of 10-15° bilaterally. Right finger to nose test poor. Dysdiadochokinesia present. Poor spatial localization on right. Poor ab- and adduction fingers on right. Poor position sense on right. Hyperactive reflexes with negative Babinski responses. Poor manual dexterity. Obese. Valgus right knee. Right hemiparesis. Heel to knee test poor on left. Poor body concepts.	2	3+	F	F	68	5	60	163°	21 - A
36.	F.S.	17	M	Outtoeing with wide-based gait and pes planus. Verticalometer error of 20° anterior with right hand, and 10° to the left with left hand.	3	4-	P	F	75	1	58	120°	7 - C
37.	S.S.	21	F	Contusion on turns.	4+	4+	F	F	92	5	59	163°	9 - C
38.	T.L.	18	F	Poor balance. Poor heel and toe walking. Only fair tandem gait. Pes planus. Head tilt to right with cervical kyphosis. 30° verticalometer error anterior when measured with right, left, and both hands. Head rocking. Tense posture.	3	4-	P	F	85	2	60	162°	14 - A

No.	Init.	Age	Sex	Ortho-Neuro-Findings	Therapy		Mobility			Psych.			Improvement Score
					B	A	B	A	IQ	I	II	III	
39.	H.B.	21	M	Tight hamstrings. Mild dorsal kyphosis. Only fair balance. Poor tandem gait. Mild pes planus. Veers to right. Fair spatial localization and stereognosis. 20° left verticalometer error when measured with left hand. Poor body concepts.	3	3	P	F	95	0	60	170°	12 - A
40.	K.C.	19	F	Obese. Mild left verticalometer error with right and left hands. Poor graphesthesia for a triangle and square. Only fair spatial localization. Poor body concepts.	3+	4-	P	P	84	0	60	160°	8 - C
41.	J.Z.	26	M	Only fair sitting posture. Poor tandem gait. CSP. Rigid gait. Pes planus. Veers to left. Poor graphesthesia. Hyperreflexia with slight ankle clonus. Questionable two point discrimination. Back leaning. Slightly athetoid. Slight circumduction gait. Head rocking. Poor body concepts.	3-	3+	P	P	58	1	54	160°	5 - C
42.	R.W.	23	M	Tight hamstrings. Outflare gait. Pes planus. Poor graphesthesia. Poor body concepts. Poor hand coordination.	3	3+	P	P	97	1	43	150°	16 - A
43.	T.M.	19	F	CSP. Poor standing posture. Left verticalometer deviation of 10° with right, left and both hands. Spastic diplegia. Mild scoliosis. Equinus feet. Hyperreflexia with ankle clonus, right worse than left. Tension adduction of hips with mild positive Babinski responses. Poor body concepts. Poor balance. Poor hand coordination.	2	3-	P	P	70	3	60	160°	15 - A

No.	Init.	Age	Sex	Ortho-Neuro-Findings	Therapy B	Therapy A	Mobility B	Mobility A	IQ	I	II	III	Improvement Score
44.	T.U.	18	M	Mild thoracic kyphosis with tight hamstrings. Anterior rocking. Slight veering to right. Hyperreflexia. Poor hand coordination.	3	4-	P	G	73	1	57	154°	6 - C
45.	R.Z.	20	F	Mild kyphosis. Verticalometer deviation of 20° posterior with right, left and both hands. Tense posture with forward head droop. Poor tandem gait. Pes planus. Poor spatial localization and poor position sense. Poor two point discrimination. Poor body concepts.	3	4-	F	G	109	1	60	170°	20 - A

IMPROVEMENT IN POSTURE THERAPY

CHART 1



IMPROVEMENT IN MOBILITY CHART 2

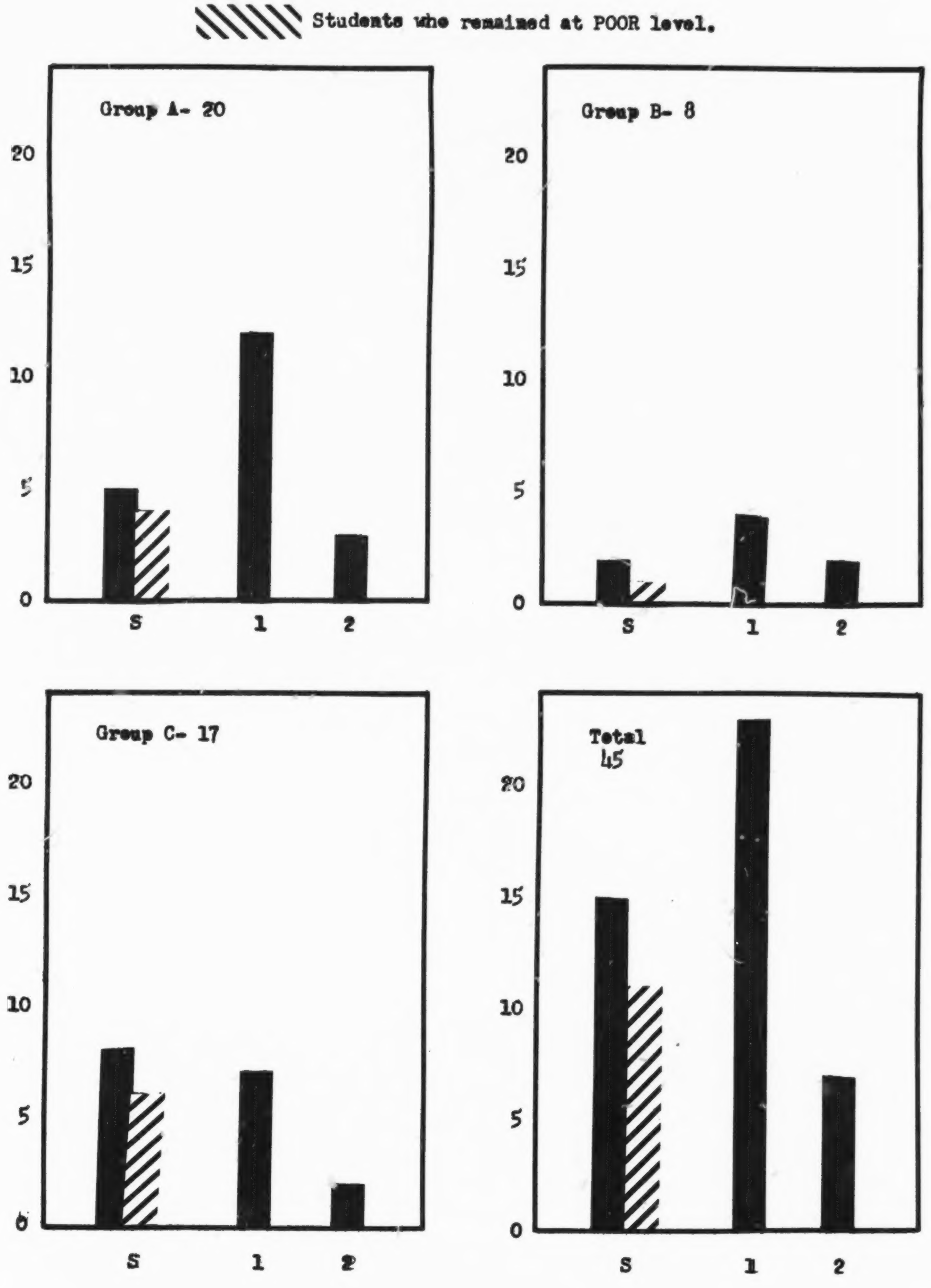
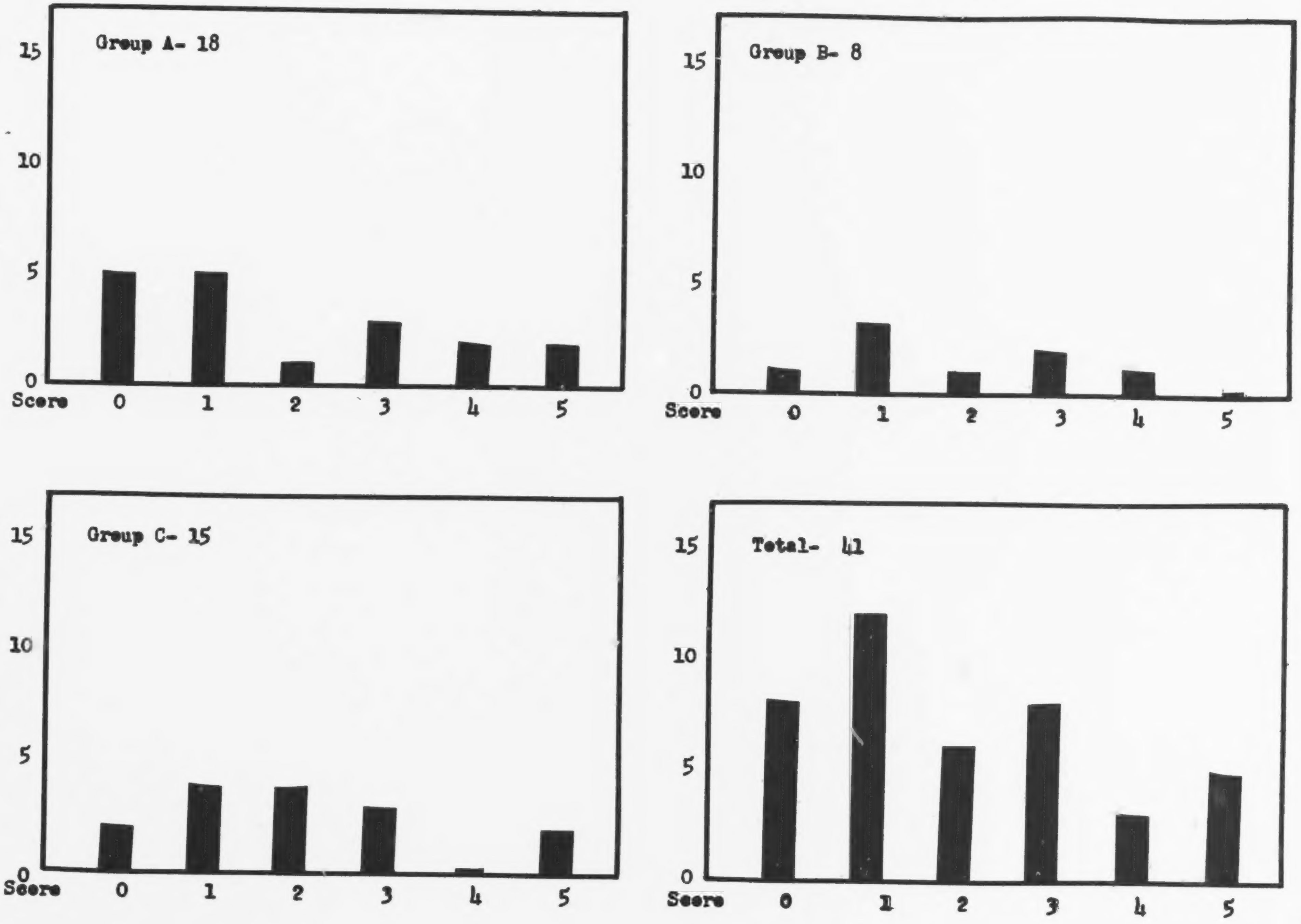


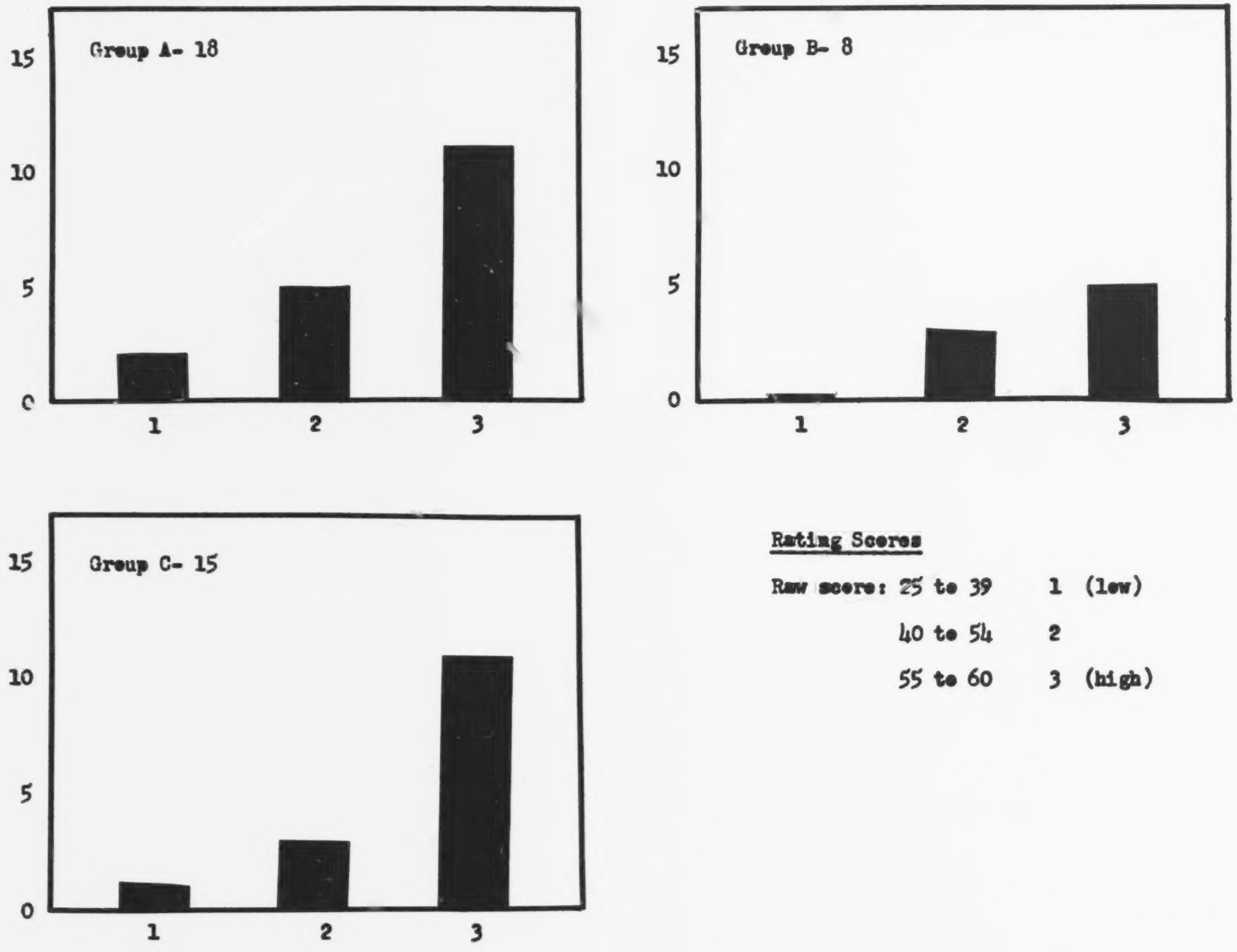
CHART 3

PSYCH. TEST I



PSYCH. TEST II

CHART 4



Rating Scores

Raw score: 25 to 39 1 (low)
40 to 54 2
55 to 60 3 (high)

PSYCH. TEST III

CHART 5

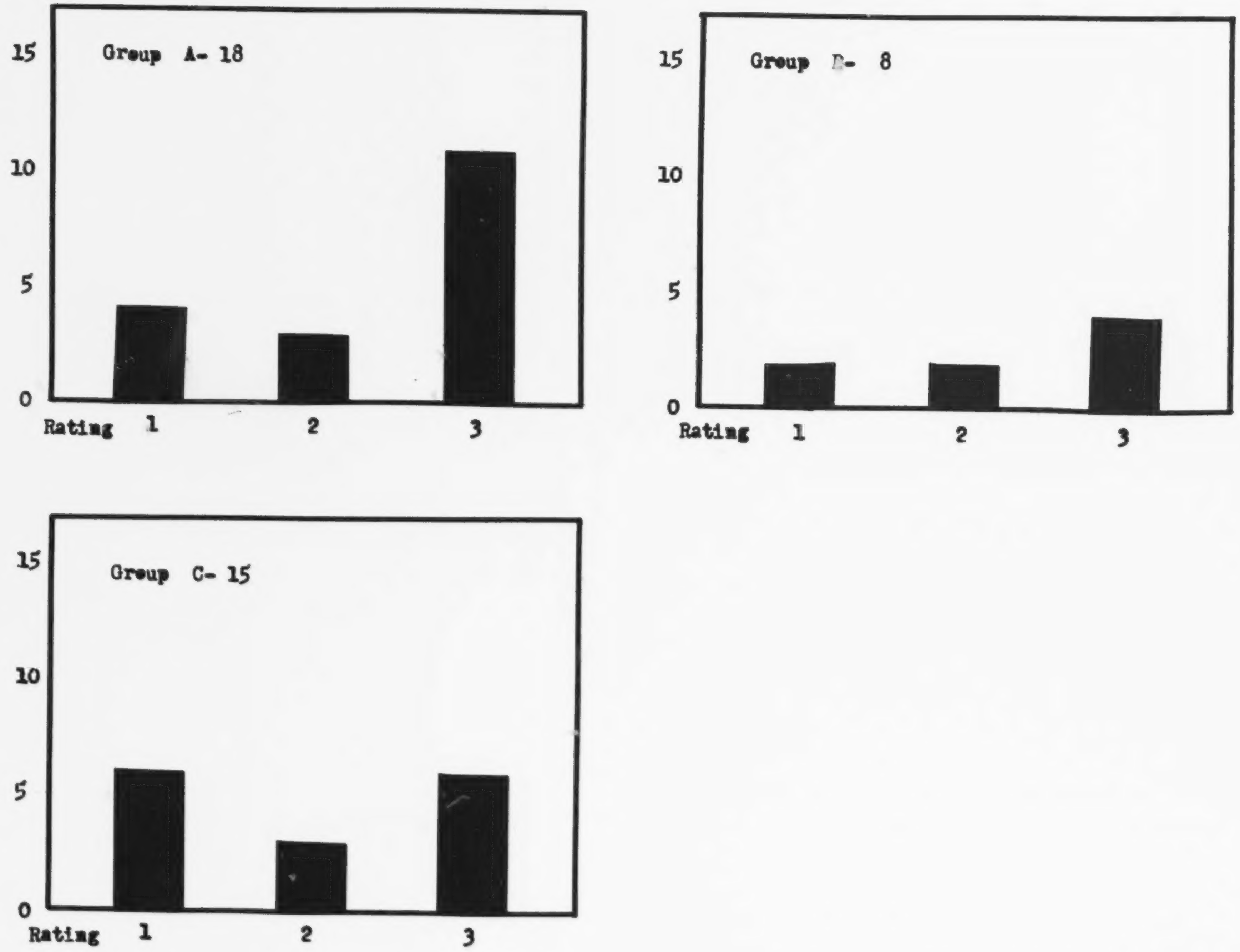
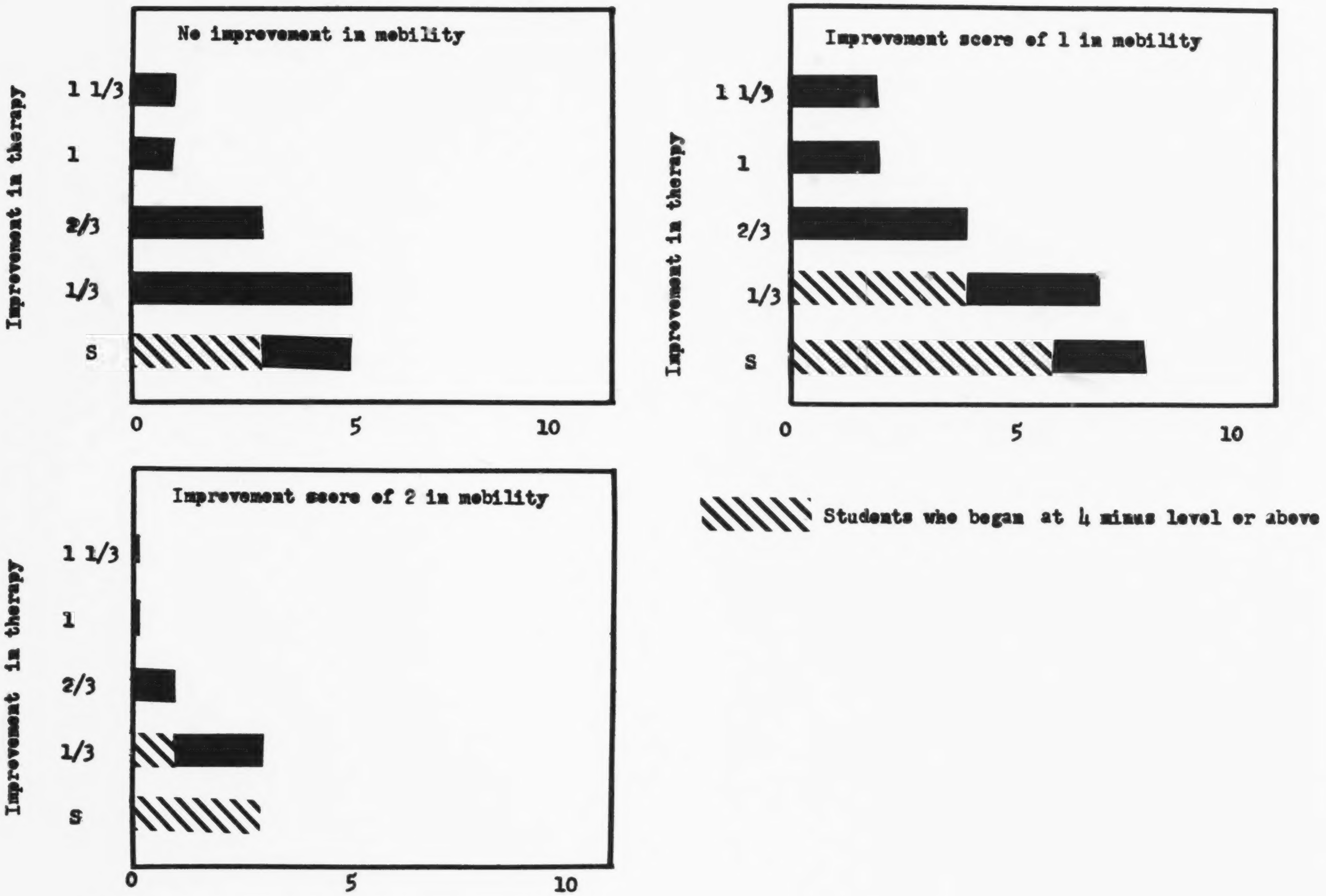


CHART 6

IMPROVEMENT IN POSTURE THERAPY & IMPROVEMENT IN MOBILITY



Summary

Posture in the blind has been investigated. Several of its determinants have been utilized in the diagnosis and treatment of malposture. Improvement in postural ability has been found to correlate with improvement in mobility skills. For those dealing with the vocational and rehabilitation problems of the blind (mobility instructors, teachers of the blind, vocational and rehabilitation counselors, etc.) some knowledge of these matters is essential. No blind rehabilitation program is complete unless it considers the postural problems of its clients. Many of these problems are peculiar to the state of blindness, particularly those present in the congenitally blind. Such things as overactive basic postural reflex mechanisms, lack of vertical sense, and poor body image contribute to the state of malposture in the blind. Occasionally, a simple orthopaedic problem, easily corrected, can play a significant role in an individual's rehabilitation potential. It seems obvious that orthopaedic, physiatric and physical therapy skills are necessary in the total rehabilitation of the blind student. Treatment must include a variety of therapeutic techniques, some newly described, tailored to meet the specific postural needs of each subject.

The practical significance of this study is that the methods herein described can be applied to any blind student with a reasonable assurance that his posture will be improved, his mobility skill increased, and his rehabilitation thus enhanced. It is hoped that the theory elaborated, as well as the diagnostic, treatment and evaluative techniques described will add to the research armamentarium of other workers in this field.

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APPENDICES

EXHIBIT 1

CFS-201
1/64

STATE OF ILLINOIS
DEPARTMENT OF CHILDREN AND FAMILY SERVICES

COMMUNITY SERVICES FOR THE VISUALLY HANDICAPPED

FACE SHEET

Name	Birth Date	Birth Place

Cross References (Alias)

Date Referred	Referred By

ADDRESSES

Date	Street Number or R.F.D. and City	County	Telephone	Teacher

RELATIVES AND OTHER INTERESTED PERSONS

Name	Address	Relationship	Telephone

Other Agency Contacts

Comments

Information Obtained By: ____Visit ____ Telephone

Other (Specify) ____ Date ______________________

PERSONAL CHARACTERISTICS

Living arrangement:
1 ☐ Living alone
2 ☐ Living with family
3 ☐ Living with unrelated person
4 ☐ Not stated
5 ☐ Nursing Home or Inst.

Religion:
1 ☐ Lutheran
2 ☐ Catholic
3 ☐ Protestant
4 ☐ Jewish
5 ☐ Christian Scientist
6 ☐ Other
7 ☐ Not stated

Race:
1 ☐ Caucasian
2 ☐ Mongolian
3 ☐ Negro
4 ☐ Other

Economic status:
1 ☐ Independent
2 ☐ Dependent

Education:
1 ☐ Grades 1 thru 4
2 ☐ Grades 5 thru 8
3 ☐ High school-incomplete
4 ☐ High school-complete
5 ☐ College-incomplete
6 ☐ College-complete

Degree of blindness:
1 ☐ Total
2 ☐ Light perception to form perception
3 ☐ Count fingers at arms length

Age at onset of blindness:
1 ☐ Birth to age 6
2 ☐ 7 - 14
3 ☐ 15 - 22
4 ☐ 23 - 54
5 ☐ 55 - 64
6 ☐ 65 and over

Other physical handicaps:
1 ☐ Mental
2 ☐ Orthopedic
3 ☐ Loss of hearing
4 ☐ Loss of other sense
5 ☐ Internal disorders
6 ☐ Other

Eye condition:

EXHIBIT 2

CFS 202
(Rev. 8-66)

STATE OF ILLINOIS
DEPARTMENT OF CHILDREN AND FAMILY SERVICES

ILLINOIS VISUALLY HANDICAPPED INSTITUTE

APPLICATION FOR ADMISSION

Name:______________________________ Date______________
Last First Middle

Address:______________________________ Telephone______________
Number Street

____
City County State Zip Code

Date of Birth:______________ Sex ________ Marital Status__________

Social Security No:______________

Family Doctor:______________________________

Address:______________________________ Telephone______________
Number Street

____
City State

Hospital Insurance:

Medical______________________ Policy No.______________
Name of Company

Surgical______________________ Policy No.______________
Name of Company

I do hereby apply for admission to the Illinois Visually Handicapped Institute and agree to undergo a two-week evaluation which includes a medical examination. The Institute has permission to release information in my file for the purpose of developing a rehabilitation plan for me.

Signed:______________________

MOBILITY EVALUATION

EXHIBIT 3

STUDENT____________________ DATE____________ INSTRUCTOR______________

I Visual Acuity

A. Risidual Vision Amount______ None______________

B. Prognosis Good _______ Poor______ Unknown___

C. Blindness Occured Birth________________ Age_______

D. Cause ________________________________

II. Use of cane

A. Carries cane Identification________ Protection__

B. Students needs cane Not At All______________________

C. Previous Mobility Instruction None____ Some______

Where____________________________

How Long_________________________

D. Student Travels Independently Yes_____ No_______

E. Describe technique(self-taught, effective, etc.)____________

____

E. Student's feelings about using cane__________________________

____

III. Orientation

A. Ability to turn on command

	Correct	Incorrect
1. 90 right turn	______	______
2. 90 left turn	______	______
3. About-face (180)	______	______
4. Complete turn (360)	______	______

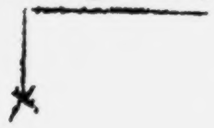
B. Ability to make compus point turns (Return student to North each time)

	Correct	Incorrect
1. Turn to East	______	______
2. Turn to West	______	______
3. Turn to South	______	______

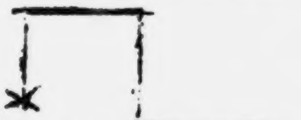
C. Continual turns (Begin with student facing North and faces student in correct position if turn was incorrect)

	Incorrect	Correct
1. Face South	______	______
2. Face East	______	______
3. Face West	______	______
4. Face South	______	______
5. Face West	______	______
6. Face North	______	______

D. Awareness of turns (walk pattern with student on arm, begin with backs to the wall and inform student he is facing North)



Ask student following questions:
1. How many directions traveled____________
2. How many turns______In what directions______
3. What direction facing on comletion of pattern______
4. Able to reproduce pattern on board Yes___No_______



1. How many directions traveled____________
2. How many turns_______In what directions___________
3. What direction facing on comletion of pattern______
4. Able to reproduce pattern on board Yes___No_______

Comments____
____

E. Memory, ability to reverse, direction, judge distance, and walk a straight line(repeat following directions as often as necessary before student begins):
Walk straight 10 feet, turn right and walk 5 feet, turn left and walk 5 feet.

1. Accurate in all areas________
2. Inaccurate in following areas (describe):
   a. Remembering directions in proper order________________
   b. Judging distance________________________
   c. Walking straight line______________________
   d. In direction of turn______In degree of turn____________
   Reverse direction to return to starting point
1. Accurate in all areas_______

2. Inaccurate (describe):______________________________

____

Comments (possible reason for errors, etc.)______________

____

____

IV Stairs

A. Fearful stairs Yes______ No_______

B. Uses cane on stairs Yes______ No_______

C. Safe on stairs Yes______ No_______

V Gait and Posture

A. Obvious postural problems exist Yes_______ No_________

Describe:______________________________

B. Student Has a normal gait Yes_____ No_______

Describe:______________________________

VI Recommendations;______________________________

____

____

EXHIBIT 4

EXPLANATION OF RATING SCALE

SUPERIOR--Student can travel independently and safely anywhere, even using public transportation, remains oriented and needs no further instruction in the area of orientation and mobility.

EXCELLENT--Student can travel independently and safely anywhere, even using public transportation, remains oriented, but may need some familiarization trips when required to travel in an unfamiliar area.

GOOD--Student cant travel independently and safely in familiar areas, but may need more instruction in the use of public transportation and in travel in unfamiliar surroundings. He may occasionally become disoriented but should, in most cases, be able to reorient self.

FAIR--Student does not yet travel independently. He will need much more formal instruction and practice in proper cane technique, concept formation, use of clues, and utilization of remaining senses. He probably has potential for reaching a "Good" rating.

POOR--Student does not travel independently. He has problems with one or more or a combination of several of the following: concept formation, use of clues, proper cane technique, use of remaining senses, judgment, comprehension, attention span, motivation, or physical limitations. The student will probably never become an independent traveler.

EXHIBIT 5

ORTHOPAEDIC EVALUATION

Data

Name:

Age:______Sex:_______Date:_____________

Diagnosis:

Congenital____Total___Partial___Progressive__Hearing__

Handedness: Left___Right___LO Foot___

Problem (why at institute?):

Past history of orthopaedic problems:

Examination:

Sitting posture
Standing posture
Romberg
Standing on each foot alone
Heel and toe walking
Tandem gait
Gait/balance
Back
Feet
Veering
Joint range of motion
Contractures or tension ticks
Finger to nose test
Dysdiadokokinesia
Spatial localization
Ab/adduction fingers
Sterognosis
Position sense
Graphesthesia
Weighing perception
Sensation
Reflexes
2 point discrimination
Manual dexterity
Vibratory sense

Hand	A	P	L	R
R				
L				
Both				

Follow-up Notes:
Date_______

Misc.

Diagnosis:

Recommendation:

EXHIBIT 6

VERTICALOMETER

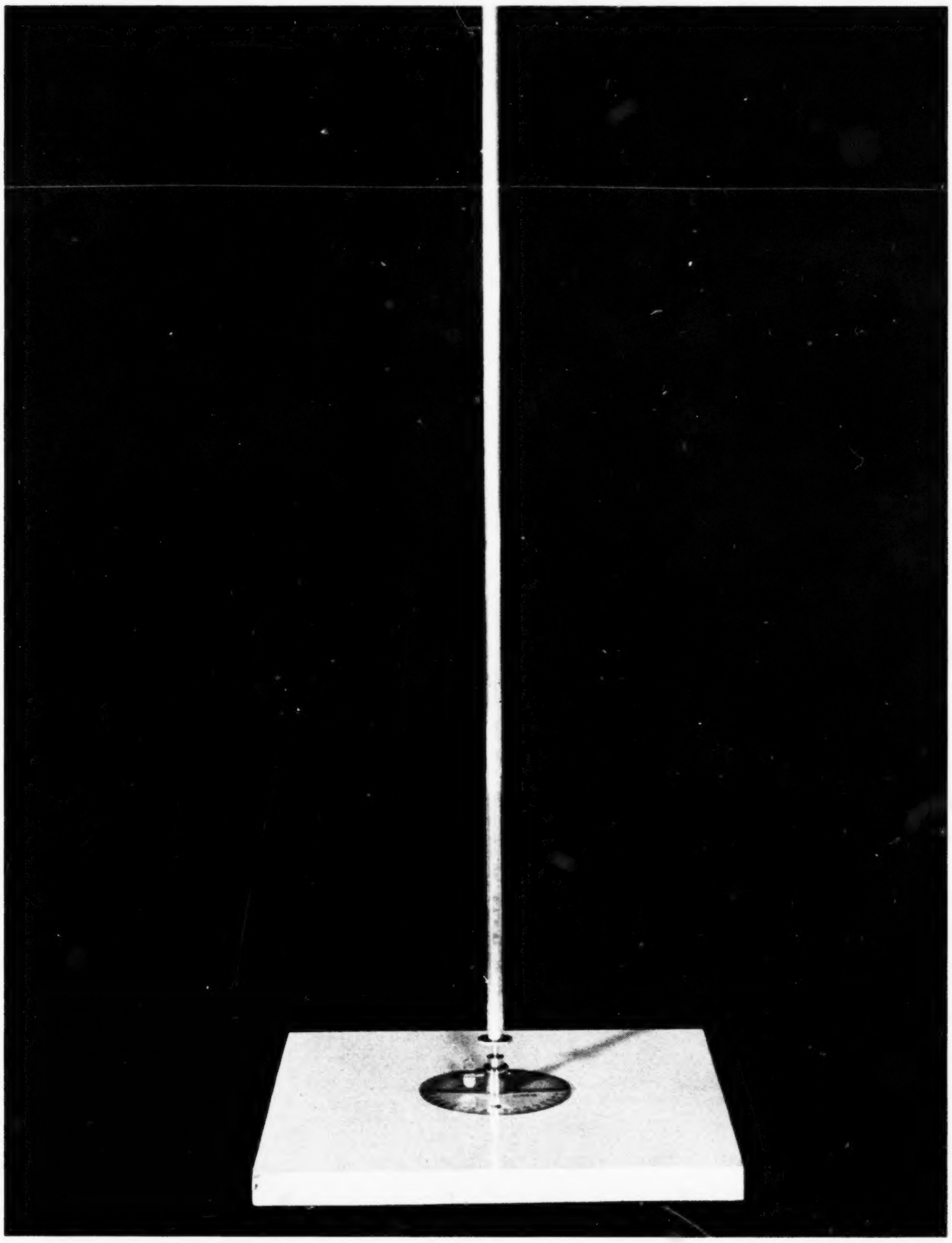


Exhibit 7

WEIGHTED WRISTLET

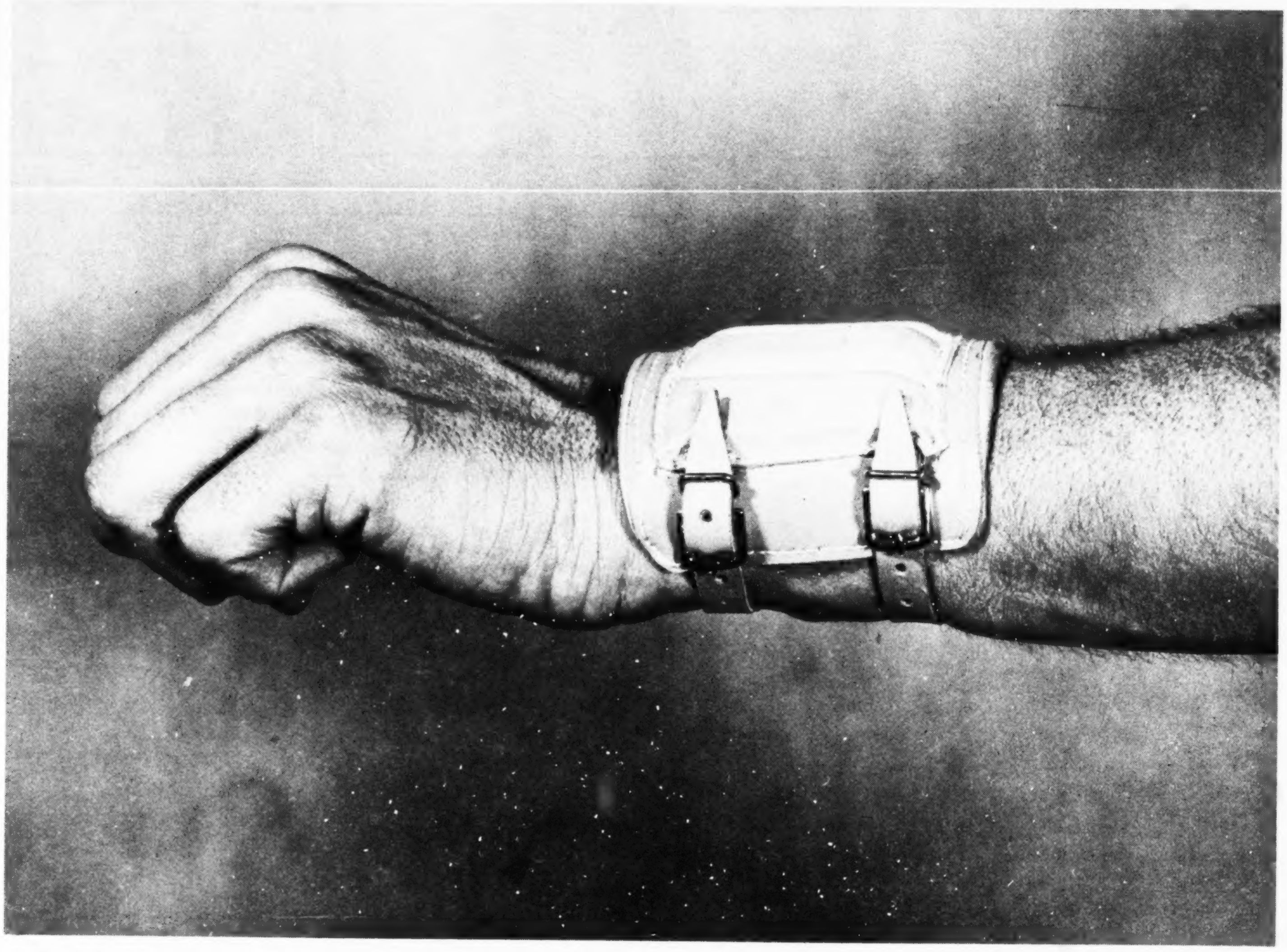


EXHIBIT 8

PHYSICAL THERAPY

Name________________________________ Age_________ Date______________________

Diagnosis____

Head drop____
Head tilt____
Shoulder slump____
Upper extremity rigidity____
Torso shift____

Dorsal Kyphosis____
Scoliosis____
Lordosis____
Abdominal protuberance____
Pelvic tilt____

Hip abduction____
Hip flexion____
Knee flexion____
Pes planus____
Out-toeing____
In-toeing____

Poor body concepts:____
____
____

Poor gait pattern:
Wide based____ Hesitant____ Propulsive____ Veering____ Other____

Poor orientation:____
____

Contractures--limitation of motion:_____________________________
____

Muscular weakness:____
____

Treatment:

Exercises:

Passive & stretching exercises___
Active & resistive exercises___
Balance exercises___
Postural exercises___
Relaxation exercises___
Scoliosis exercises___

Gait training___
Crawling___
Treadmill___
Slantboard___
Balance beam___
Pulley___

Body concept training:

Orient. with wall___
Orient. with fam___
Mannequin___
Tunnel___
Trampoline___
Appliances___

Miscellaneous:____

Progress Notes:

Date______________________

EXHIBIT 9

TACTILE DISCRIMINATION TESTS

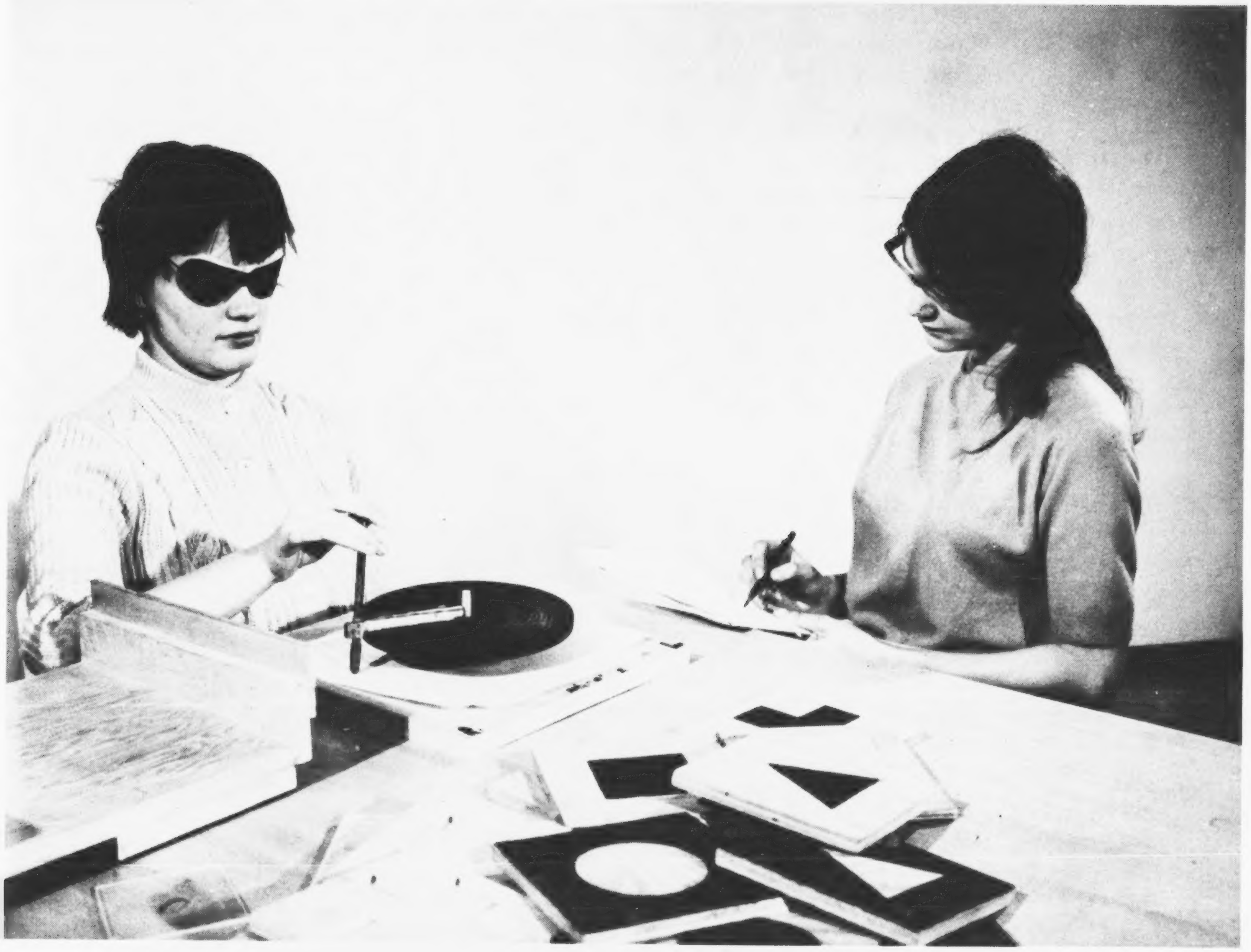


EXHIBIT 10

FORM CONCEPTS

INSTRUCTION AND TALLY

		Score Pre-Post
1a	Here is a piece of plastic - can you tell me what shape it is?	□ ________
	What shape is this one?	△ ________
	What shape is this one?	○ ________
	What shape is this one?	✚ ________
1b	Here is a piece of wood with a shape on it.	
	Can you tell me what shape this is?	✚ ________
	What shape this is?	○ ________
	What shape this is?	□ ________
	What shape this is?	△ ________
1c	Same as above - figure ground	△ ________
	What shape is this?	✚ ________
	What shape is this?	○ ________
	What shape is this?	□ ________
1d	Same as above - sand paper inside	○ ________
	What shape is this?	△ ________
	What shape is this?	✚ ________
	What shape is this?	□ ________
1e	Same as above - sandpaper outside	✚ ________
	What shape is this?	□ ________
	What shape is this?	○ ________
	What shape is this?	△ ________

Training! Present each form in all media - allowing student to examine tactually while E identifies each verbally.

2a Through e repeat of phase one - same sequences.

3 Place all forms in front of student in mixed order.
Now I want you to sort these out.
Put all the Same Shapes together
Make four piles
Number correct △ ______ ○ ______ □ ______ ✚ ______

Exhibit 11

TALLY SHEET TEST OF PARALLELITY

Position	↑	↓	⇡	↓
180°				
170				
160				
150				
140				
130				
120				
110				
100				
90				
100				
110				
120				
130				
140				
150				
160				
170				
180				

S = Same (parallel)
D = Different (non-parallel)

EXHIBIT 12

PARALLELITY INSTRUCTIONS

Here are two pieces of wood. Run your index fingers along the top edges. You'll notice that they are parallel, that is, they go in exactly the same direction all the way to the end. Now, the piece of wood on your right can be moved and I'm going to move it to different positions - then I'll ask you whether the two pieces are parallel or not. You may run your fingers along the pieces two times, back and forth, then tell me whether they're going in the same direction all the way to the end, that is, whether they're parallel or not.

Run four trials, alternating ascending and descending series, scoring S or D - same or different.

EXHIBIT 13

TURNING

INSTRUCTIONS AND TALLY

Let student examine apparatus, then introduce all 8 positions from a zero point alternating right and left turns.

Now I'll ask you to hold the pen and turn it (left or right). Always begin at zero point for each trial. Use following sequence.

Number of Degree of S's Turn.

____________ 1. Full Turn left (all the way around) 0 - 360°

____________ 2. Quarter way right (0-90°)

____________ 3. Half-way around right (0-180°)

____________ 4. Three-Quarters of the way around left (0-270°)

____________ 5. Three-Quarters of the way around right (0-270°)

____________ 6. Full turn right (0-360°)

____________ 7. Quarter way left (0-90°)

____________ 8. Halfway around left (0-180°)

EXHIBIT 14

MONTESSORI EQUIPMENT

EXHIBIT 15

LIFE SIZE MANNEQUIN

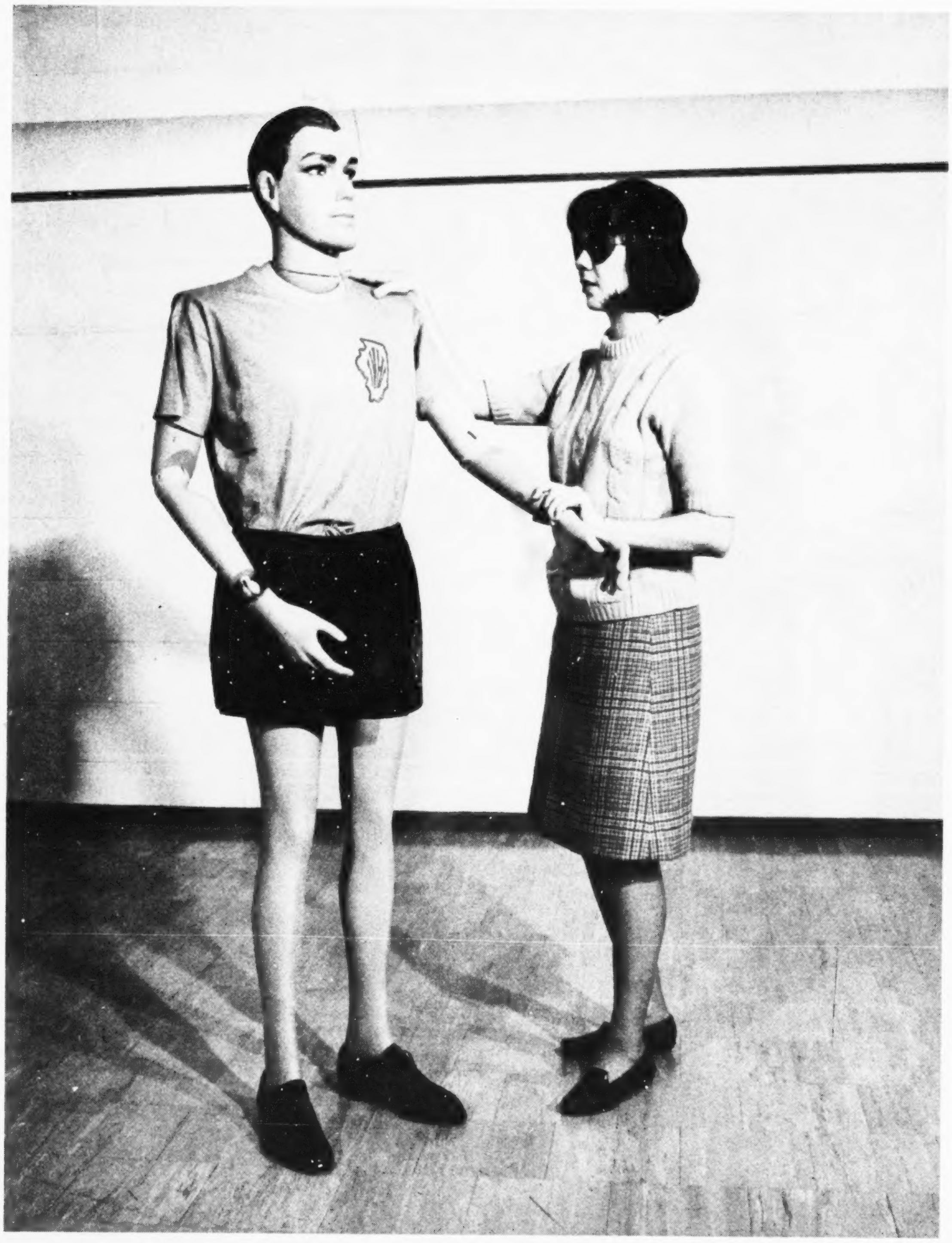


EXHIBIT 16

"WIND TUNNEL"

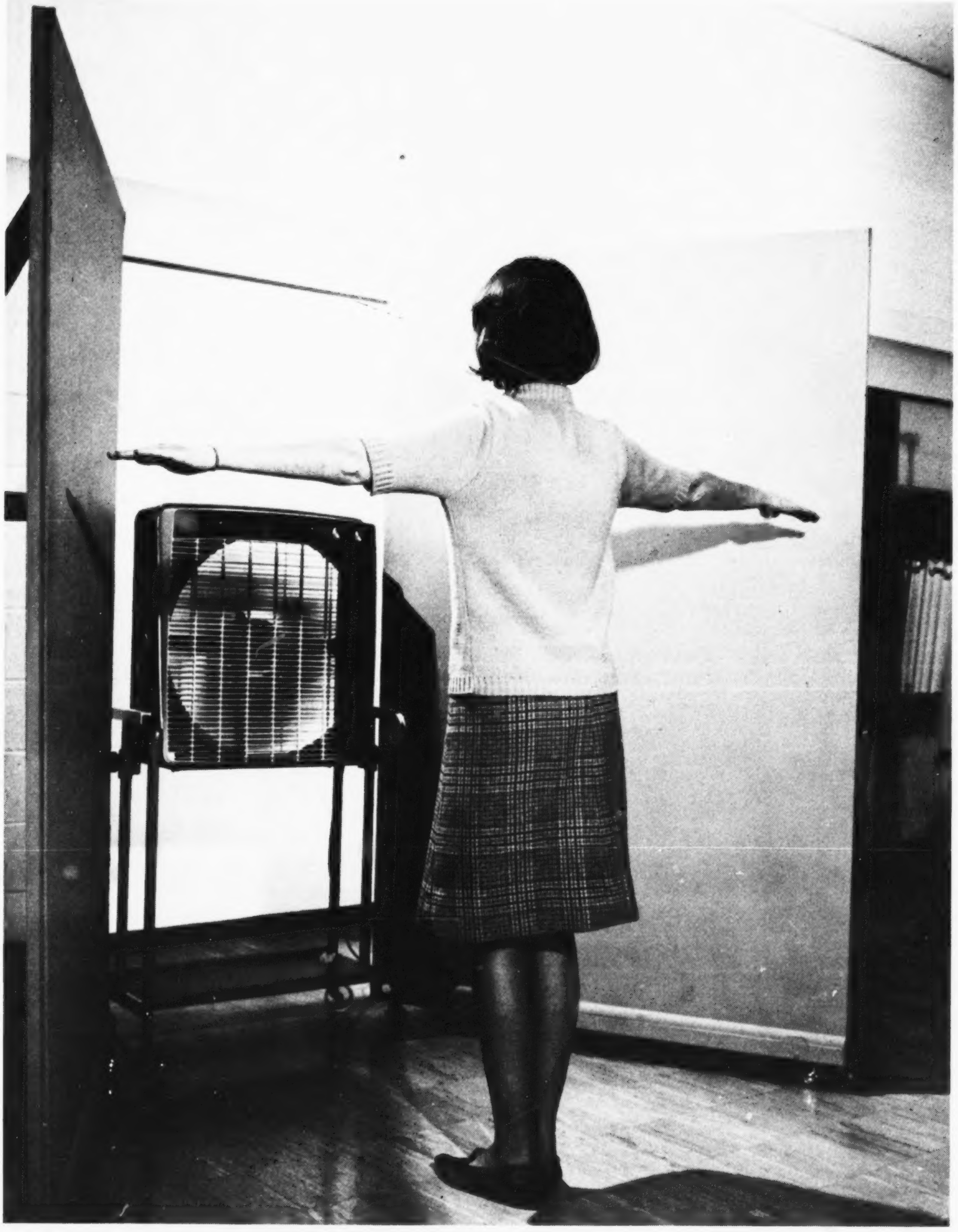


EXHIBIT 17

ILLINOIS VISUALLY HANDICAPPED INSTITUTE

POSTURAL EXERCISES

SERIES I

Dr. I. M. Siegel

Exercise I.

A. Correct standing position (abdominal muscles and posterior hip muscles tightened).
B. Full inspiration.
C. Raise arms forward over head, (elbows, wrists and fingers extended), very slowly.
D. Stretch arm upward at top of arm movement.
E. Return arms to starting position in the same arc of movement, same rhythm and resistance as in C.
F. Exhale.

Exercise II.

Same as in I, except that arms are raised to the sides. The palms are turned up upon reaching shoulder level so that the palms face each other above the head at the top of the movement.

Exercise III.

Same as in I, except that the hands are placed behind the head. The elbows are then brought in to the center, and returned to the sides.

Exercise IV.

Lateral bending of trunk right and left.
A. Correct standing position, hands may be placed on hips.
B. Full inspiration.
C. Bend the body to the side (all movement takes place at the waist).
D. Return to upright position.
E. Exhale.
Repeat to opposite side.

Exercise V.

Forward bending of trunk.
A. Correct standing position, hands may be placed on hips.
B. Bend trunk at the hip joints, maintaining straight position of the back and head.
C. Return to correct position.
D. Exhale.
Caution: Bend only as far as correct position of the back can be held without pain or strain.

Exercise VI.

Balance Series.
A. Correct standing position, hands may be placed on hips.
B. Full inspiration.

C. Shift weight onto one foot, raise opposite leg with knee straight. At first one may only be able to raise the leg a few inches without losing balance. As strength and co-ordination improve, this will gradually increase.
D. Return leg to starting position.
E. Exhale.
This exercise is repeated, bringing right and left legs forward; then right and left legs sideward; and finally right and left legs backward. Each time the same procedure is followed as given in the example above.

SERIES II

Shoulder Motion - with arms at sides.

Exercise I.
Raise tips of shoulders toward ears, and then relax.

Exercise II.
Pull shoulders back (so shoulder blades come together in center of back), and then forward. Relax to starting position.

Exercise III.
Bring shoulders and forward (at same time) and then down and back.
Repeat each exercise 5 - 10 times slowly.

Additional Exercises
1. Standing and sitting on floor, with knees straight, touch fingers to toes.
2. Bend head forward so chin touches chest, and then tilt head backward.
3. Turn head to the right and then to the left, keeping rest of body still.

EXHIBIT 18

FELT AND STOCKINETTE COLLAR

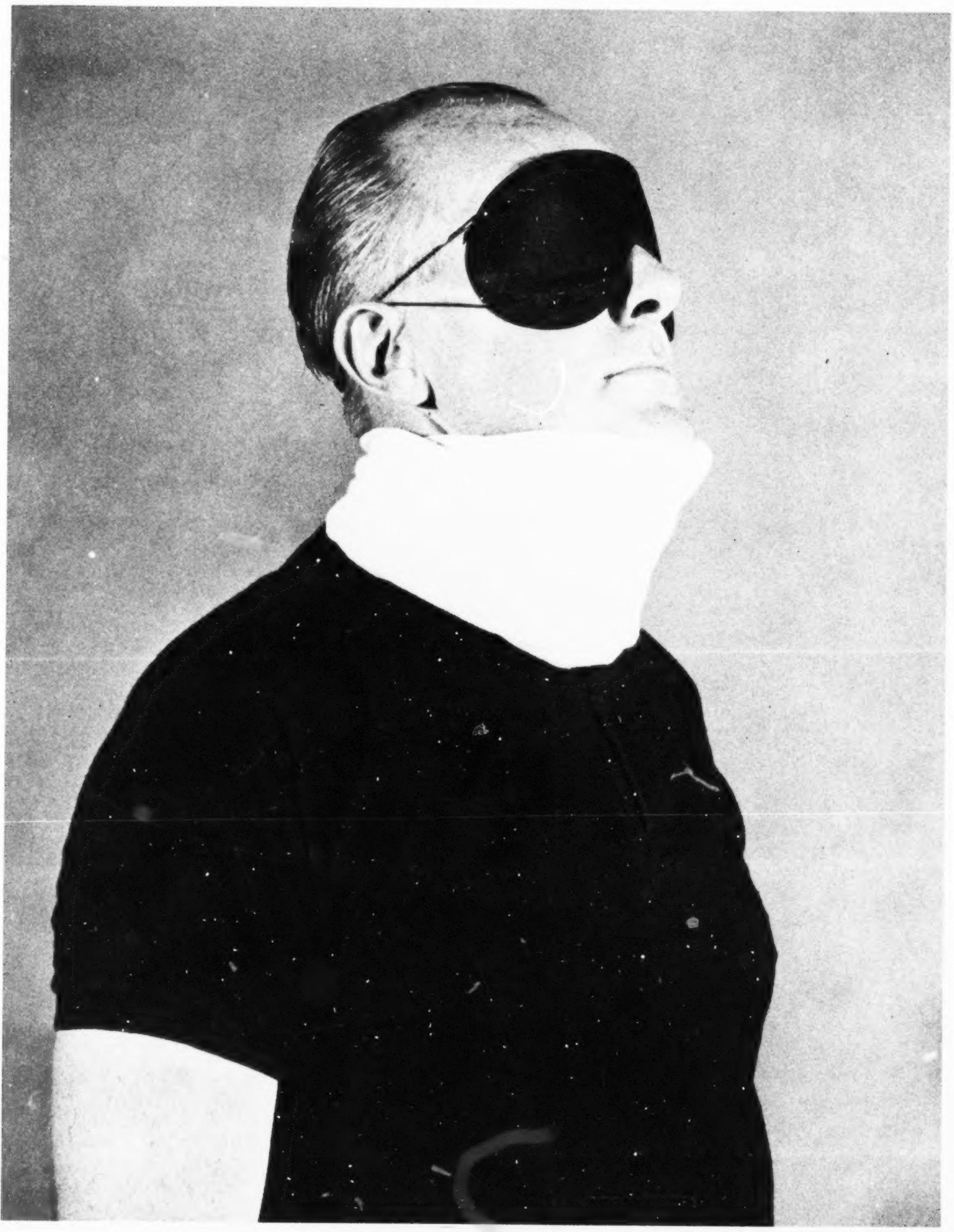


Exhibit 19

LIGHT SHOULDER SPLINT - FRONT

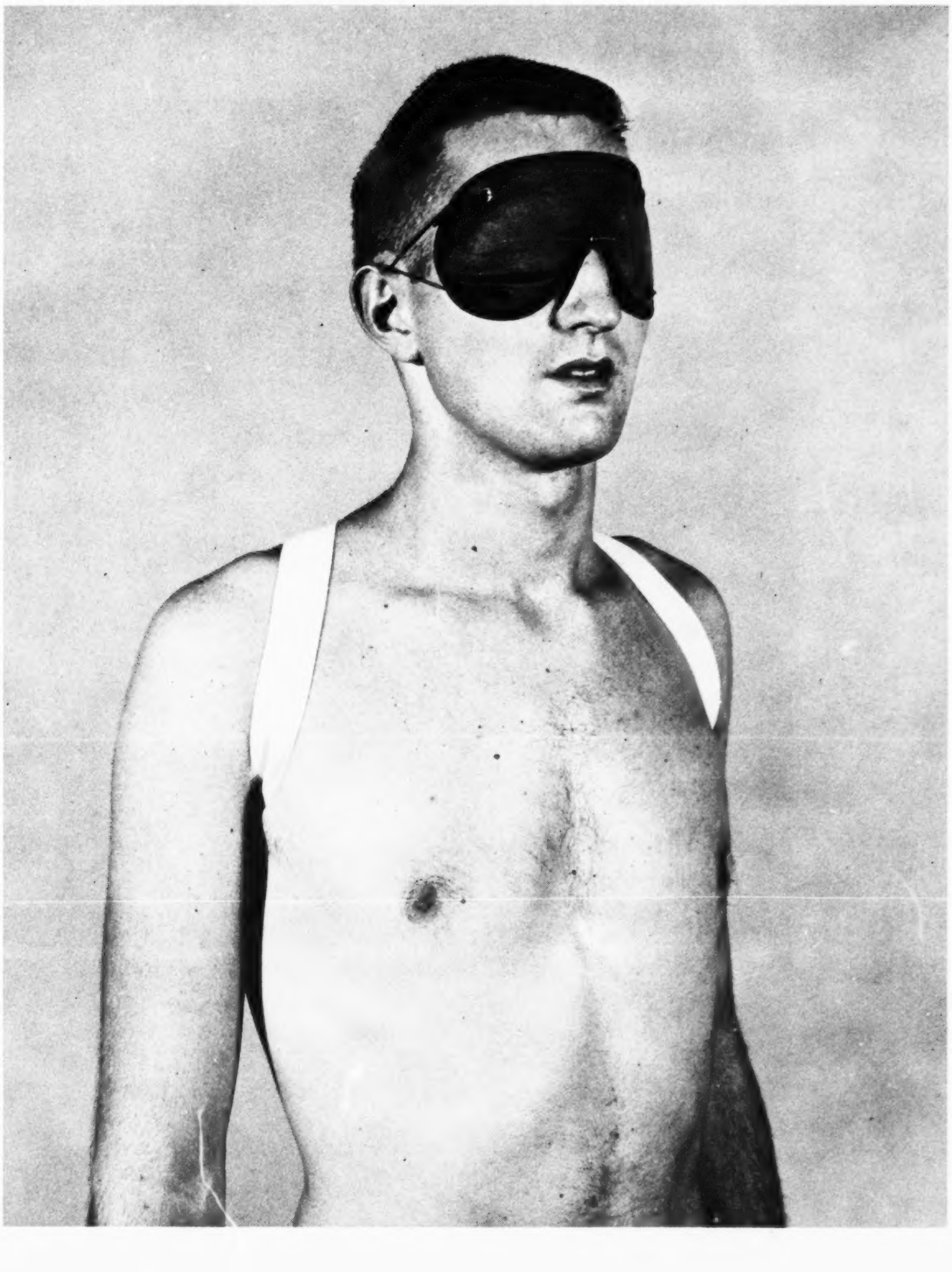


EXHIBIT 20

TRAMPOLINE AND HARNESS WITH "SPOTTERS"

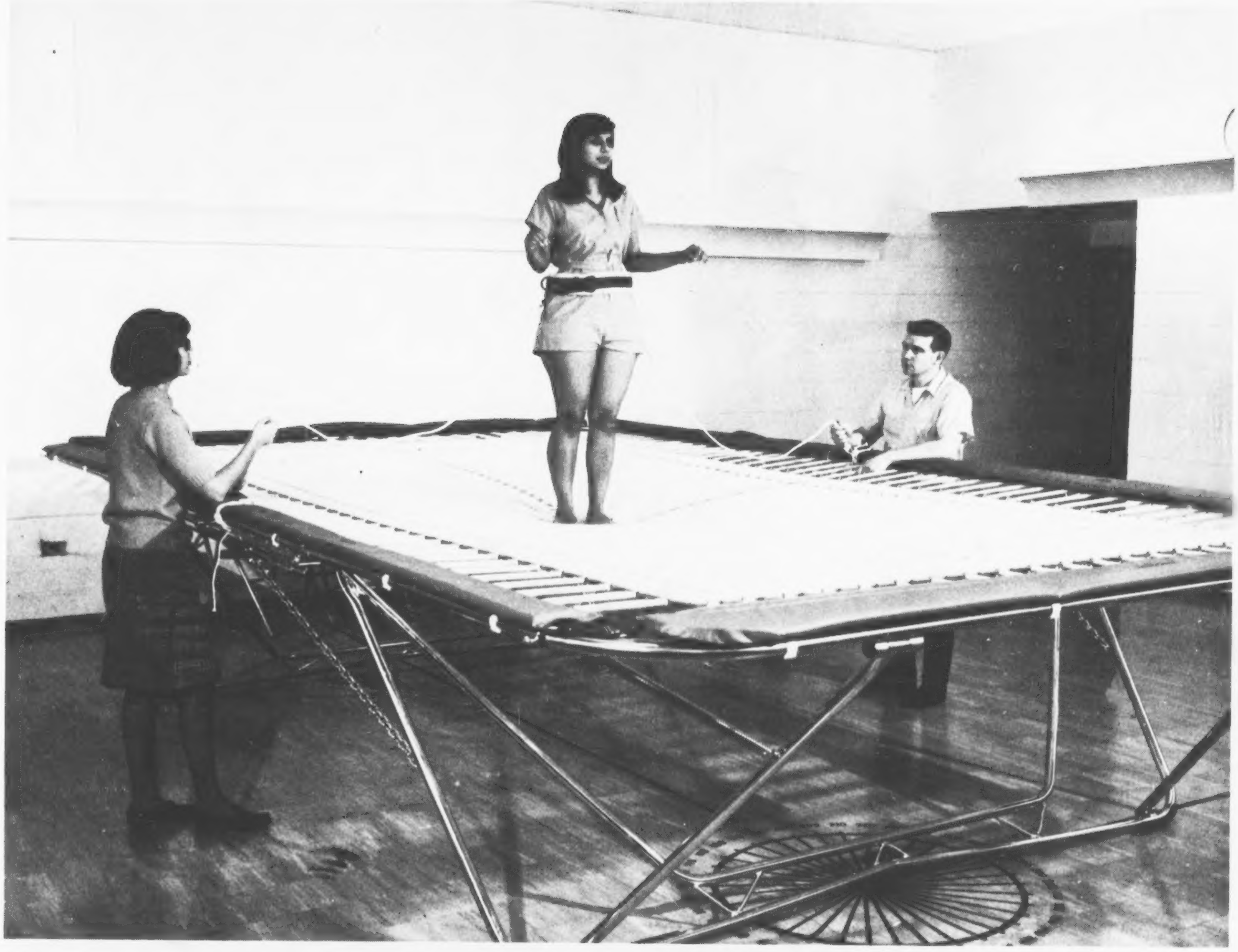


EXHIBIT 21

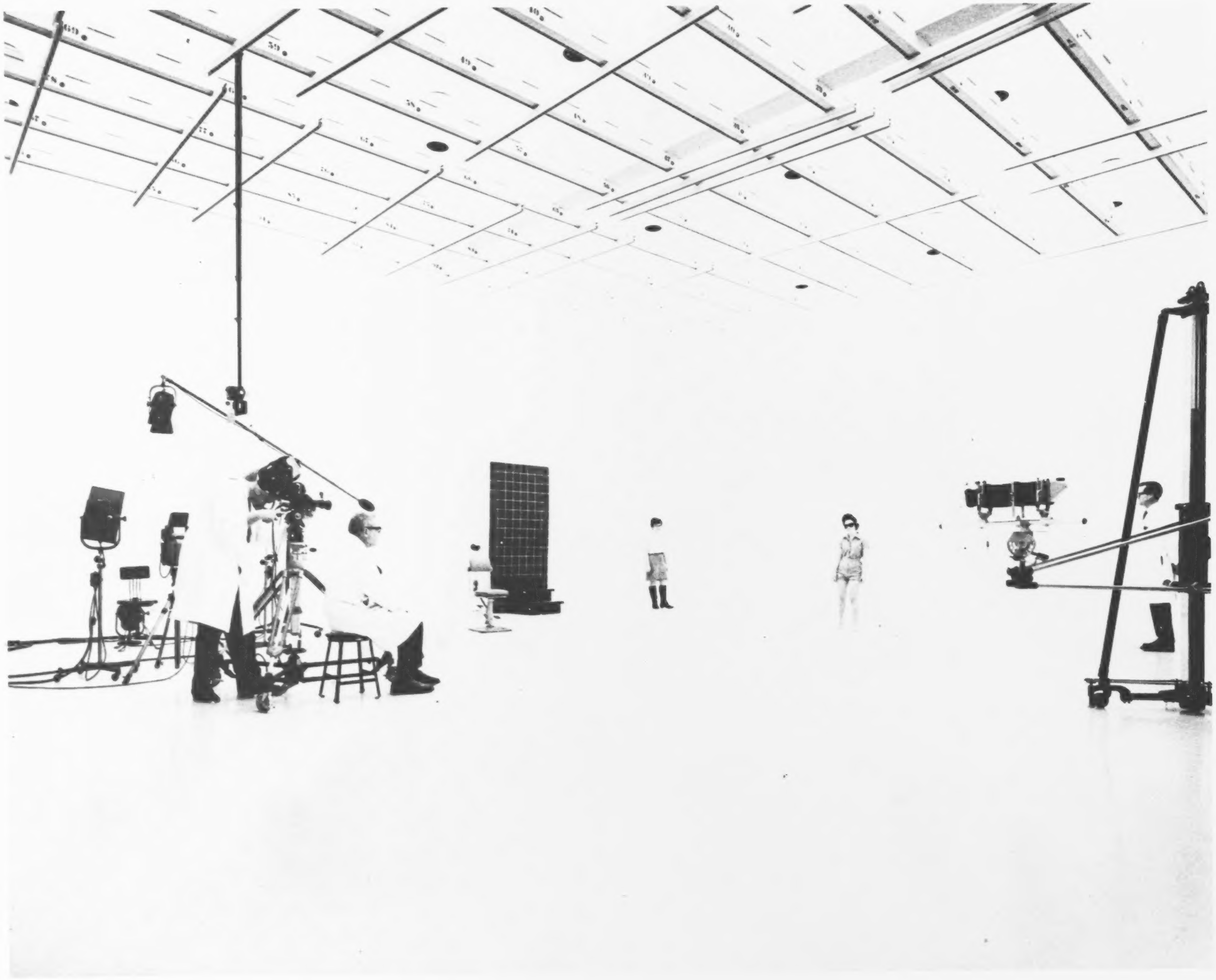


EXHIBIT 22

RATING SCALE - PHYSICAL THERAPY

1.

Very poor posture with many postural defects. Very poor balance with inability to stand alone on one foot. Inadequate gait pattern. Walks alone with considerable effort. Considerable muscle weakness or limitation of range of motion in joints. Very poor body concept with limited knowledge of body parts and awareness of limb positions. Very poor orientation - unable to orient in strange surroundings.

2.

Poor posture with several postural defects or marked tenseness. Poor balance with ability to stand on one foot only momentarily. Poor gait pattern with more than one major gait problem (i.e. outtoeing, shuffling, marked veering, etc.). Muscle weakness of trunk muscles and at least one other body area. Some limitation of range of motion. Poor body concept with confusion concerning location and relationship of body parts. Poor orientation with unsureness of shapes and difficulty in strange surroundings.

3.

Fair posture with one or more postural defects and/or some tenseness. Fair balance with ability to stand on one foot for a short time (5-10 seconds). Fair gait pattern with only one major gait problem. Some muscle weakness, primarily in the trunk muscles. Some limitation of range of motion, primarily in the heel cords, hamstrings or pectorals. Fair body concept with confusion with more complicated joint motions and some relationships of body parts. Fair orientation with some initial difficulty orienting but ability to orient after several attempts.

4.

Acceptable posture with only minor postural defects or ticks. Adequate balance. Able to stand on one foot at least ten to fifteen seconds. Acceptable gait pattern with only minor defects (i.e. some veering or slight outtoeing, etc.). Normal muscle strength and normal range of motion. Adequate body concept with adequate orientation and only minor difficulty in strange surroundings.

5.

Good posture with no noticeable postural defects or ticks. Good balance with ability to stand on one foot without difficulty and good gait pattern with no gait defects. Normal muscle strength determined by manual testing and full range of motion of all joints. Good body concept with awareness of joint motions and body position and knowledge of body relationships. Good orientation with ability to execute turns and determine shapes and dimensions in strange surroundings.

EXHIBIT 23

EXHIBIT 24

EXHIBIT 25

EXHIBIT 26

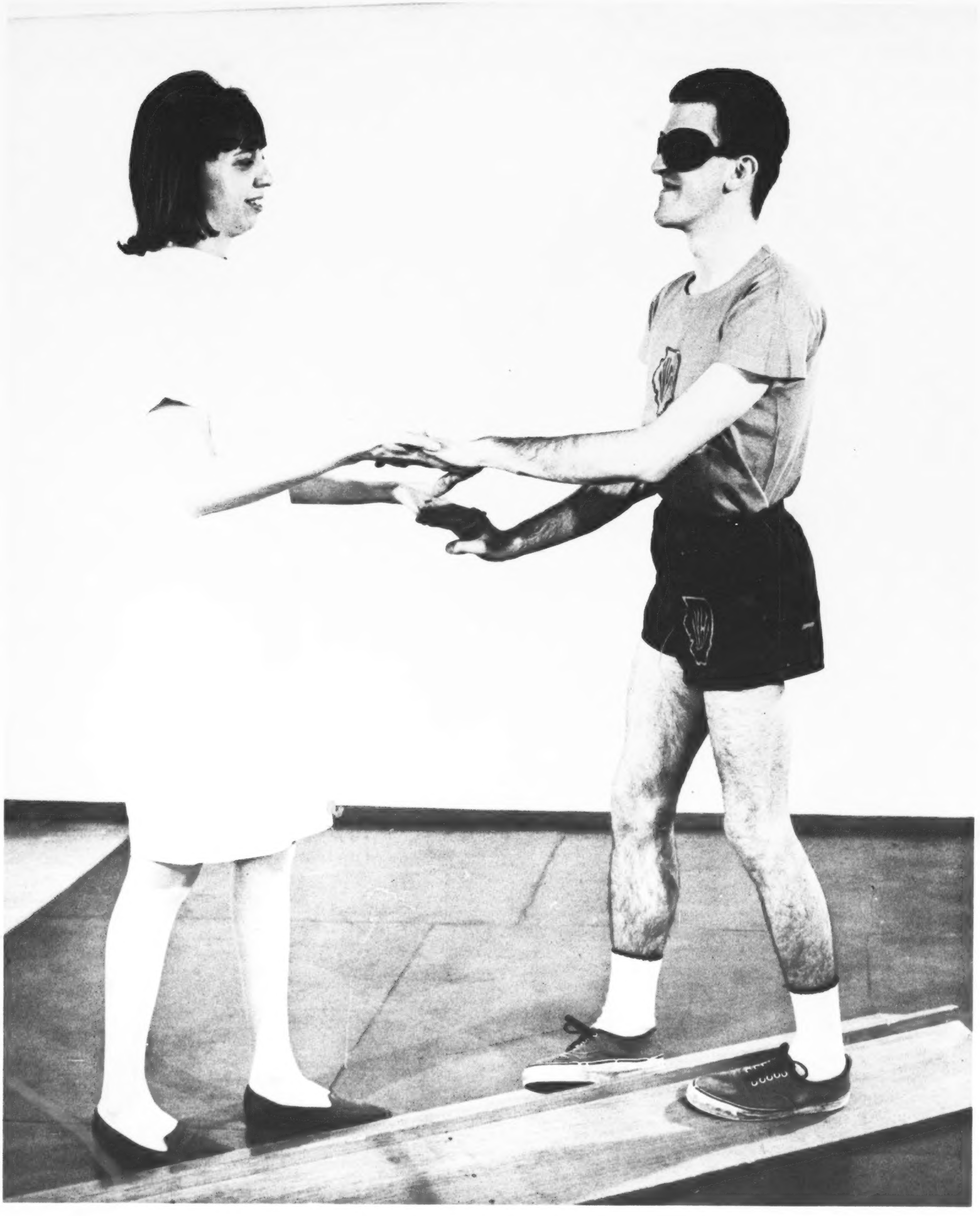


EXHIBIT 27

EXHIBIT 28

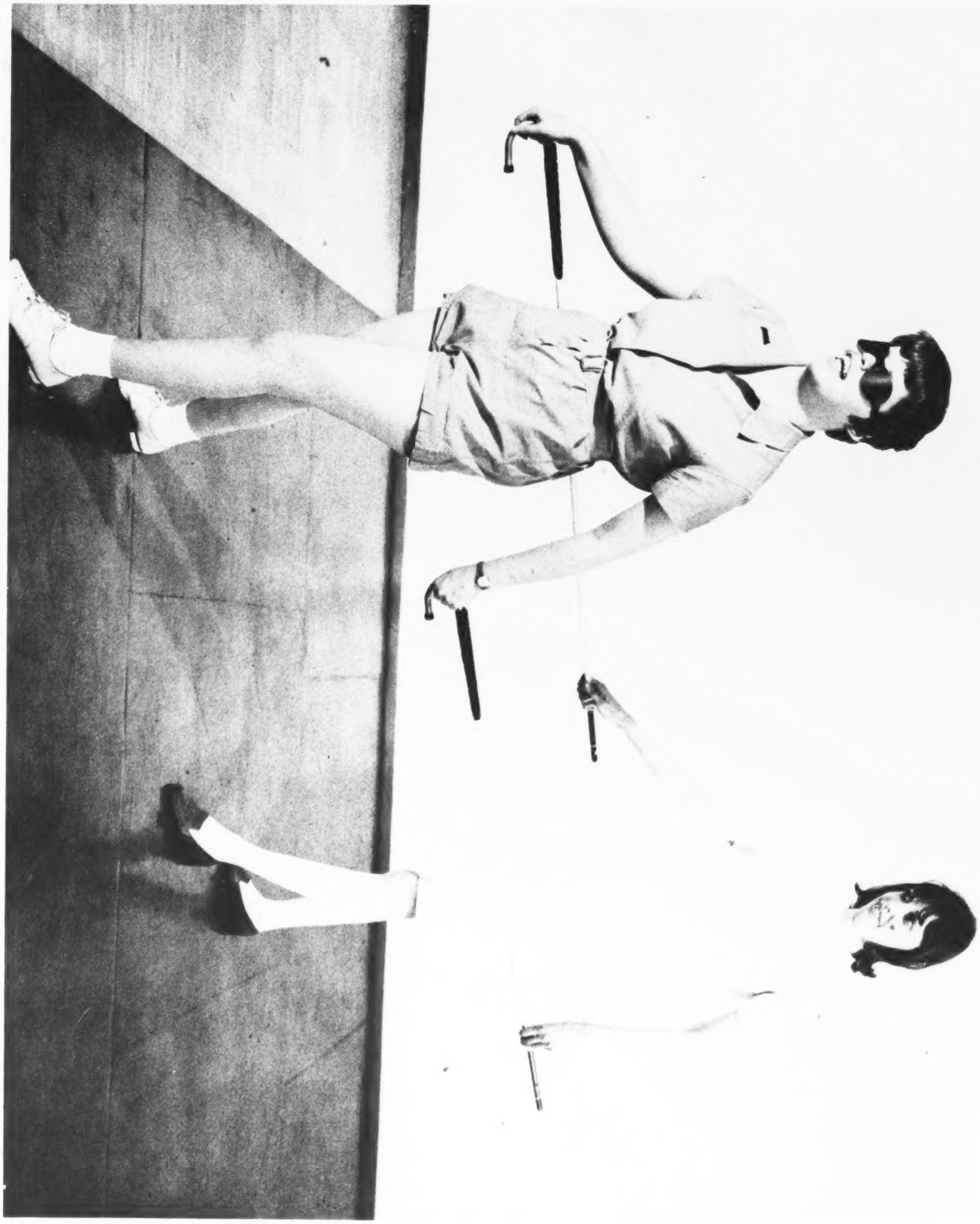


EXHIBIT 29